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WESTERN ARTS ASSOCIATION CONVENTION

The Western Arts Association this year holds its convention on May 3, 4, 5, and 6 at Columbus, Ohio. The keynote will be "The Primacy of the Arts."

Dr. William E. Warner, of the Ohio State University, Columbus, president of this organization, and his co-officers are to be congratulated upon their efficiency. Not only have they set up an especially strong and interesting program of events to be presented, but they were ready to distribute well-arranged printed copies of it early in December. A glance at their program shows that much thought and real planning was spent on every detail of it.

Copies thereof may be obtained from the secretary, Mr. Harry E. Wood, 5215 College Avenue, Indianapolis, Indiana.

EASTERN ARTS ASSOCIATION CONVENTION

Washington, D. C., will be the meeting place for the convention of the Eastern Arts Association, April 26, 27, 28, and 29, 1933. The theme for the convention will be "The New Fundamentals in Education."

Copies of the program are obtainable from the secretary, Burton A. Adams, Technical High School, Springfield, Massachusetts.

THIS MONTH'S COVER

The cover picture this month shows the ramming up of the drag section of a mold on a jar-ram, roll-over, and draw-molding machine.

Photo courtesy of Aluminum Co. of America, Pittsburgh, Pa.

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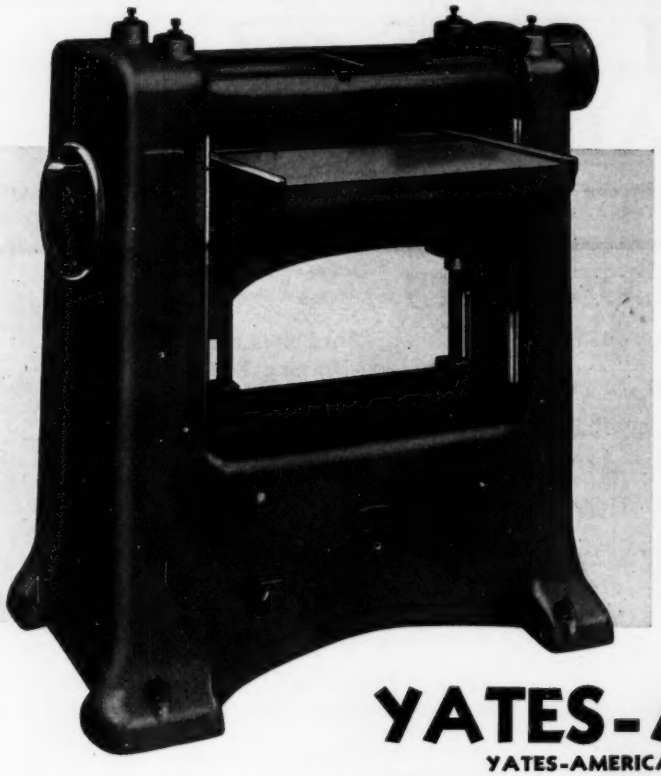

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INDUSTRIAL ARTS and VOCATIONAL EDUCATION
March, 1933
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The Practical-Arts Teacher

Arthur B. Mays

Professor of Industrial Education, University of Illinois, Urbana, Illinois

A fine analysis of what the industrial arts requires of those who essay to teach it. The kind of article which may cause some shop teachers to examine themselves critically.

TEACHING the practical arts of the race is one of the oldest forms of educational endeavor. Long before the concept of education for culture was born, men, as a matter of course, taught their children how to perform the skillful tasks necessary in the providing of food, clothing, shelter, ornaments, and weapons. For centuries after the rise of civilization such arts were taught to sons and daughters by parents as a necessary part of the rearing of children, and later by master workers as an essential feature of apprenticeship. This early teaching of the practical arts was singularly effective, as is attested by the remarkably beautiful and skillfuly wrought relics which persist as priceless mementos of earlier human life. The pottery, jewelry, bits of fabrics, weapons, monuments and buildings, the priceless books and manuscripts which have remained from earlier times, indicate clearly that in past ages the teaching of such arts was carefully performed. But it was left for the present era to create the distinct vocation of teacher of the practical arts. In this day of specialization, some of the oldest of the traditional functions of parenthood have, one by one, been assigned to specialists; and among them is the teaching of the homely arts of supplying the necessaries of life. This striking shift of duties has occurred so recently that the new sort of teacher is still occasionally looked upon as an interloper, and his status as an educational specialist is only now beginning to be generally recognized. The recency of the advent of this new teacher necessitates a definition of his place in the scheme of education. When he first appeared on the scene, he was regarded by some as a sort of magician who would, at one stroke, solve two of the major problems of modern education; namely, (1) the problem of vocational education of secondary grade, and (2) the pressing need of a closer relationship between the school and contemporary economic and social life. Neither of these was a simple task, and the factors involved were scarcely understood by any; but least of all by the new teachers. Gradually, however, both the magnitude and the essential conditions of these problems came to be appreciated, and there followed a slow but continuous lifting of the fog of misunderstanding surrounding the new teachers of the ancient arts of the common life. By slow degrees it became clear that there must be two kinds of practical-arts teachers, one who would prepare youth as workers in the skilled vocations, and one who would teach these arts for purposes of appreciation and personal development. The first was seen as a teacher (not necessarily a school teacher) of vocational education; the other as a school teacher of general education.

This distinction greatly simplifies the definition of the functions of these new teachers. The vocational teacher has a very specific task of preparing young people for participation in the skills and activities of specialized occupations. He must be an experienced practitioner of the occupation he undertakes to train others in; and his work requires techniques and surroundings which are characteristic of the occupation to be taught, rather than those of the schools. His problem is unique, but his task is clearly outlined, and his achievement is easily measured, in terms of the vocational success of his pupils. He has come to be known as a "vocational" teacher, and is usually set apart both from teachers in general and from the other practical-arts teachers. Much study by special agencies is given to the problems of the vocational teacher; and the occupational world is quite as interested in his welfare and progress as the educational world. His preparation and qualifications have received very careful attention, and they have been very specifically defined by the educational and other institutions concerned with his training and employment. His status may change from time to time, but it doubtless will continue to be easily defined; and his obvious economic importance insures his future and the growth of his field of activity.

Practical Arts and the Curriculum

But what of the practical-arts teacher who is to be found only in the realm of general education? What is his place in the scheme of modern life? Strangely enough he, and not his brother in vocational education, is popularly known as a "practical-arts teacher." And we shall, from this point, also, speak of him only as "the practical-arts teacher." His field of work is no more clearly defined than that of any other division of general, or cultural, education. His preparation and

qualifications, after fifty years of working with him, is just now being made comparable with those of all the other teachers in the schools. When he first arrived, school heads did not know what to think of him, and, since he rarely was welcome, little effort was expended in trying to understand him or his work. He did such strange things as a school teacher, that for many years he was, for the most part, not considered a "regular" teacher. Indeed, even today the old distinction is sometimes made between "regular" teachers and "special" teachers, though the actual basis for the use of the words "regular" and "special" is hard to define. But the lot of the practical-arts teacher has slowly become a happier one, as he has come more fully to appreciate the importance of his contribution to the new life of civilization, and hence, more adequately to prepare himself for his work. Step by step he has moved his habitat from the school basement to the upper floors, and his status from that of a glorified day laborer to a professional educator. This advance has been a slow, and oftentimes painful, process, but it has taken place, and the future is altogether bright with promise of greater progress.

Evolution of the Practical-Arts Teacher

The first step upward in the evolution of the practical-arts teacher came when he was able clearly to see his task as a very important feature of general education. This clarifying of his function pointed the way for his professional advancement. It clearly meant that he must not only possess the manual skills and technical facts of his particular division of the practical arts, but he must also be in possession of a sound general education and understand, at least as well as his "academic" colleagues, the purposes and processes of general education. Fortunately he was forced by the nature of his teaching subjects to keep in close contact with the workaday world about him. This prevented his becoming "bookish" and unpractical. His interests have, of necessity, been those of the boys and girls who are thoroughly alive to the busy life going on about them. This has made him of great value as a teacher of youth. It has also offered the temptation of neglecting the necessary study of books and the great facts of life which do not express themselves in material objects. Many have failed from yielding to this temptation. The close relationship between teacher and pupil, which the methods of teaching the arts make necessary, give teachers of the practical-arts exceptional opportunities to touch for good the lives of their pupils; and only men and women of high quality and thorough education can do really effective teaching in this field of education. The steady improvement, during recent years, of the quality of the personnel engaged in this work is evidence that school authorities are beginning to realize the importance of carefully selecting the teachers who are to initiate boys and girls into the appreciations and skills of the arts of the race upon which the maintenance of human life depends.

Practical-arts teaching in these days is a vocation of great opportunities for growth and service; growth because of the rapidly changing life of civilized man, and the consequent need for enlarged knowledge and ready adaptability; service, because of the great need of the new generation for an increasing appreciation of, and skill in the making and using of the things belonging to modern civilization. Let us consider the demands of our day which make continuous growth a necessary factor in the life of the successful practical-arts teacher. As has already been suggested, whether one be dealing with the arts of industry, agriculture, commerce, or homemaking, he is engaged in a human activity which touches life at many points and is vital to the very existence of civilization itself. Hence, merely to understand something of the larger significance of his work requires both an extensive and a profound study of the basic facts of human existence. No high-school shop teacher, for instance, can arrive at any sort of adequate comprehension of the meaning of his work without some knowledge of economic history, of modern industry, of the evolution of social history, of educational philosophy, of the growth and implications of democracy and the trends of contemporary civilization. Hence, if one makes any sort of effective effort to encompass the real functions, values and relationships of his field of work, he is forced into a kind of study which makes growth inevitable. To say that some shop teachers never make the effort, in no wise affects the truth and importance of this fact. But, whether a teacher recognize such an opportunity for growth or not, he must enlarge both his general and specialized knowledge in order to meet the demands of a changing economic and social order. New methods of work, new fashions in design, new standards of craftsmanship, new theories and practices of education, new requirements of professional training and achievement, and new expansions in this field of activity force either failure or growth upon the practical-arts teacher. Because of the close relationships of the practical-arts courses with the changing world of affairs outside the school, stagnation either of method or content soon becomes obvious and extremely objectionable. Teachers of courses less immediately connected with the busy, rapidly moving world of practical activities may, with much more plausibility of excuse, fall into a rut and cease to move on to new ground. Every factor of the situation surrounding the practical-arts teacher, however, points the way to growth; only his own blindness, or disinclination to follow the signs, will prevent him from making continuous progress upward.

The Value of Practical-Arts Courses

Teaching boys and girls to appreciate the practical arts of the race, to use the products of those arts with intelligence and skill, and to practice them with efficiency and wisdom is no trivial service for one to render to society. The value of that service is directly proportional to the quality of the understanding and skill which the teacher puts into his work. Such teaching ought itself to be seen as an art, and the teacher as an artist who knows not only how to reach definable ends, but what ends he desires to reach, and why. Merely to know how to paint a picture makes of no one an artist. Before one becomes a real artist he must have ideals of beauty, constructive purposes and an understanding of meanings. He must also have a worthy idea to express by means of his art. Only then do mere techniques become significant and valuable.

But still no very important results are reached unless all these are bound together by that impalpable quality sometimes called "creative genius." Surely those who teach others the history of man's craftsmanship and his ways of creating the things of value in human life, ought themselves to be unusually creative. Theirs should be the spirit of the fine artist rather than that of the machine operative. Their greatest service will be rendered when they become the finest craftsmen they are capable of being; and theirs is the craftsmanship which has to do with the hands, eyes, brains, and hearts of boys and girls.

The importance of the service rendered by the teacher of the practical arts becomes increasingly great as the practical arts themselves play a larger and ever larger part in civilized life. Man's environment today is a most amazing complex of manufactured products, technical processes, and situations demanding motor skills. One needs today, for effective community life, all the traditional knowledge, esthetic appreciation, and understanding of life that any of the greatest preceding generations possessed. But in addition to these, he must know a vast number of facts about useful devices and products of many sorts, which to know, requires much technical understanding. And more than this, he must be able wisely and effectively to use these devices and products and to perform many highly skillful operations involved in their use. This age is variously known as the "industrial age," "the machine age," "the age of super-power," "the scientific age," and "the age of the engineer." All these expressions suggest the environmental demand of practical-arts education of the highest possible effectiveness. Hence, in this era of history, the practical-arts teacher is indeed a servant of society who may justly feel that his is a work of great value, destined to become of increasing importance as the years go by.

Teaching is an adventure, and all real teachers are adventurers. When the spirit of romance, of questing, and of daring die in a man, he can no longer be a teacher of the first rank. This is true of all teaching, but there is something peculiarly challenging to the spirit of adventure in the practical-arts courses. In these activities one deals with boys and girls who are thoroughly alive to their work, with ideas pushing out and demanding expression. The very materials with which they work stir their imaginations and heat their desires to create. Most anything exciting may happen under these conditions, and much does happen. A teacher who does not feel the thrill of such a situation must be phlegmatic indeed, and surely has missed his proper vocation in life. Live, eager pupils need the same kind of teachers. And, to fail to extract all the possibilities of real romance from the challenge of a band of vigorous young human minds and hands ready to make something, and to experience the thrills which creative activity always carries, is indeed to fail tragically.

But, fully to appreciate the adventurous nature of the finest type of practical-arts teaching, one must himself know the joys of real craftsmanship in the materials under his pupil's hands. The practical-arts teacher, then, must be an artist in two realms; he must be a master craftsman, and a master teacher. This implies long years of preparation. The young man or young woman unwilling to pay the price of much study and many hours of trying to become a skillful worker ought not attempt to become a teacher of the practical arts. The time is past when it is wise to try to use this field of teaching as a "stepping-stone." Too much of the best years of life are now required for preparation and the starting experiences, to expend them on any but a permanent investment. Let us, then, more and more, warn the unfit to seek happiness elsewhere, and urge the brightest of those "who would teach another" to consider the life of the good teacher of the practical arts, if they want adventure, growth, and the consciousness of rendering high service.

Securing the Right Kind of Light

Elroy W. Bollinger

Chairman Department of Industrial Arts and Engineering Shops, University of North Dakota, Grand Forks, N. Dak.

This very practical article on how to secure the right kind of lighting system for the school shop is written by a schoolman for schoolmen.

THE teacher who is questioning the lighting practice in his school shop or room is merely reacting to the growing feeling in his profession that all is not well with the physical plant in which he works. Methods, content, pupil study, testing, job sheets, equipment, etc., has occupied the focus of professional attention so exclusively that many fail to note the progress in other things about us.

Illumination is an example. It has progressed far beyond the old carbon-filament bulb and narrow, heavily framed windows so sparingly used 25 years ago. It is interesting to know that the efficiency of the electric-light bulb has increased from four lumens per watt in 1905 to 14 lumens per watt in 1931, and that as much as 26 lumens per watt are obtained from larger-sized bulbs. This means that almost seven times as much light is obtained today for the same amount of current consumed. The changes in the utilization of daylight are more obvious and visible than artificial illumination. Outside walls have virtually become glass. Surfaces not used for bearing purposes are now devoted to windows. Window frames, sash, mullions, and muntins are reduced to the minimum to allow for the maximum admittance of light.

The Problem of Artificial Illumination

While the use of natural illumination in school buildings has made marked progress, the development of artificial light has tended to minimize the importance of nature as a source of illumination. The Simonds Saw Co., for instance, in its new plant at Fitchburg, Mass., discarded all windows, and depend entirely on artificial illumination. In this way they are assured of illumination that is practically constant.

Natural light during the summer may frequently vary in intensity as much as 400 per cent within the space of a few minutes. Obviously working conditions cannot be adjusted

to this wide fluctuation of the light source without producing overillumination in the one case and underillumination in the other.

This article has chosen to deal only with artificial illumination for two reasons: First, illuminating engineers, largely through the Illuminating Engineering Society have now devised terms, methods, and instruments dealing with illumination that make it possible to recommend, to advise, and instruct those concerned with the problem of lighting. This progress has been so marked that all concerned with problems of lighting should have their attention brought to bear on the topic. Second, few of us can do anything about existing conditions of natural light, windows are not easily changed or rooms rearranged, but each and every teacher can *take inventory* of the artificial-lighting conditions and inaugurate steps to bring them up to date.

Lighting Terminology

The study of illumination, like other technical investigations, has brought forth new terms especially adopted to describe conditions of lighting. Accordingly, a few of these commonly used terms and their definitions are given here as a means of clarifying the discussion that follows:

Candle power. The luminous intensity of a light source in any one given direction measured in terms of the *number of standard candles* it would take to reproduce that intensity. Thus the amount of light emitted from an electric bulb might be expressed in terms of "Standard candles" or candle power.

Fig. 1

Fig. 2. Foot-candle meters

Foot-candle. A unit of measurement of intensity on an object equal to the amount of light falling on any given *point* of perpendicular surface one foot from a standard candle.

Lumen. A unit of measure for *quantity* of light equal to the amount of light from a standard candle falling on an area of one square foot one foot from the source, or with an intensity of one foot-candle.

Brightness. The amount of light emitted, or reflected, from a surface measured in terms of *candle power per square inch;* i.e., a 200-watt bulb in a 10-in. glass bowl has a brightness of approximately 2¼ candle power per square inch.

Luminaire. A luminaire is a complete *lighting unit or fixture* consisting of a light source, together with its globe, reflector, refractor, housing, and supports.

Coefficient of Utilization. The ratio between the light emitted by a light source and the amount reaching the working plane.

Reflection factor. The ratio of light reflected from a surface to the light falling upon it, usually quoted as the per cent of light reflected as measured in foot-candles.

Measurement of Light

Most of the terms defined have to do with the measurement of light. This phase of the lighting problem has been developed to insure more accurate and objective observation of lighting conditions. The measurement of light intensity, in foot-candles, has been greatly simplified through the development of a foot-candle meter, simple and convenient enough to be owned and operated by the layman. Two commercial models are shown in Figures 1 and 2. Both instruments are small, easily portable, and sufficiently accurate for all practical purposes. They may be placed in the working plane and the intensity read off directly in terms of foot-candles.

Since the foot-candle is a measure of intensity of light at any point, it offers a convenient index by which the amount of light needed or available may be stated and compared. But while the foot-candle gives a measure of light intensity it does not represent all the factors involved in good seeing. The General Electric Company's bulletin, *Lighting for Seeing,* has this to say on this topic:

"The foot-candle is only a measure of intensity of illumination. It is not a measure of seeing. As an influence upon seeing its value is not fixed, for, other conditions remaining the same, the effectiveness of a foot-candle, as a direct aid to seeing diminishes as the level of illumination increases. To double our ability to see it is necessary to increase the level of illumination many times if other factors are not altered. The effectiveness of an additional foot-candle depends upon at least three primary factors: (1) the visual difficulty of the work which the eyes must perform, (2) the manner in which the additional light is used; and (3) the level of illumination to which it is added. But it is also possible to alter quality, direction, diffusion, and distribution of light with a resulting increase in ability to see in many cases."

Light Diffusion

The brightness of a lighting unit is measured in candle power per square inch of apparent area. Authorities seem to agree that this should not exceed three candles per square inch and preferably less. There is some validity to this figure when one knows that the brightness of the sky rarely exceeds this amount. Brightness of a light source in excess of three candles per square inch becomes a possible source of destructive *glare.* For light units continually in the line of vision, the brightness should not exceed one-half candle per square inch if undue eye fatigue is not to result. The brightness of light sources may be reduced by inclosing them in translucent globes that tend to distribute the brightness over their entire surface; e.g., a 200-watt clear bulb emits about 180 candles, but inclosed in a 12-in. white globe the 180 candles are distributed over an area of approximately 110 square inches or 1.6 candles per square inch, a value well within the limits of safety and suitable for most purposes where the fixture is not continually in the line of vision.

Brightness of *reflecting surfaces* may be just as distracting and dangerous as direct glare. This form of glare presents itself more frequently because it usually comes from, or below,

the working plane and so falls in the direct line of vision. Such conditions are best treated in one of two ways: (1) by moving the light source so that the reflection is thrown away from the worker; (2) by treating the surface to diffuse and absorb the light rather than reflect the full brightness of the source since the source determines the brightness of the reflected image.

It is because of glare, or the reflected brightness of light sources, that glossy paint and finishes should be avoided on walls, machines, and benches. Figures 3 and 4 illustrate diagramatically how glare is reduced by surface treatment.

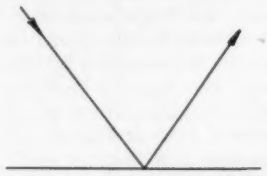

Fig. 3. Reflection of light from a glossy surface

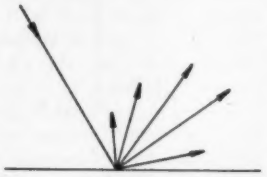

Fig. 4. Reflection of light from a dull surface—Note dispersion

The absence of glare usually denotes diffusion of light, and good diffusion reduces the sharpness of shadows, both of these qualities are normally sought after in good lighting practice. Sharp contrasting shadows are dangerous in shops and impossible in drafting rooms. However, some types of work require a sufficient amount of shadow to produce an effect of relief: type, in printing, and molds in foundry work, are examples in point.

TABLE I
Reflection Factors of Different Colored Paints

Material	*Color*	*Reflection Factor in Per Cent*
Paper	White	80
Paint	Aluminum	52
Paint (gloss)	Mill white	70
Paint (flat)	Mill white	74
Wall paint (flat)	White	76
Paint (flat)	Very light gray	70
Paint (flat)	Ivory white	80
Paint (flat)	Ivory	71
Paint (flat)	Ivory tan	63
Paint (flat)	French gray	44
Paint (flat)	Dark gray	19
Paint (flat)	Buff	64
Paint (flat)	Cocoanut brown	19
Paint (flat)	Satin green (light)	56
Paint (flat)	Sage green	41
Paint (flat)	Olive green	21
Paint (flat)	Azure blue	55
Paint (flat)	Sky blue	37
Paint (flat)	Shell pink	54
Paint (flat)	Cardinal red	20

While it is usually desirable that reflecting surfaces diffuse the light well, it is equally important that a large per cent of the light falling on these surfaces be reflected to the working areas and hence improve the efficiency of the lighting system. For school shops and drawing rooms, lighting data usually recommends that all ceilings should be white, creamy white, or ivory, not to exceed a semigloss in finish. The creamy white and ivory are frequently preferred to the less interesting white. The walls above the eye level should be of a light color, such as cream, ivory, light tan, warm light gray, light green, etc. Below the eye level, somewhat darker shades of the same color, as used for the upper part of the walls, may be used. A table of reflection factors for several colors and kinds of paint are given in Table I, as taken from the General Electric Company's pamphlet *Illumination Design Data for Industrial and Commercial Interiors.*

Lighting Fixtures

Having spoken of qualities of illumination it might be well to turn to the question of luminaires, in view of these requirements.

Lighting fixtures are usually divided into three types: direct, semi-indirect, and the totally indirect. The direct-lighting fixture is one utilizing a shade or reflector, frequently combined with an inclosing bowl that directs the light downward on to the work plane. The semi-indirect is one which reflects the major portion of the light toward the ceiling, but by using a translucent bowl reflector permits some light to fall directly on the work. The totally indirect fixture reflects all the light to the ceiling from which it is reflected to the work plane.

For industrial purposes the direct-lighting plan has been most in favor. The dome reflector shown in section 1, Table IV, is the RLM Standard Dome. This fixture is made by several manufacturers to conform with standard specifications with regard to contour and quality of reflecting surface. It is a porcelain-enamel reflector, very durable and highly efficient. Either clear or frosted bulbs may be used with this luminaire but care must be taken that the proper size and type of bulb be used or its standard characteristics, on which lighting-design data is furnished, will be seriously effected. Lamps of 50, 60, and 100 watts, inside-frosted, should be used with 12-in. reflectors, 100-watt inside-frosted with socket extension, and 150-watt lamps with the 14-in. reflector, 200-watt lamps with 16-in., and 300–500-watt with an 18-in. reflector. These combinations have been so worked out that the contour of the reflector avoids undue concentration directly below the fixture and gives an output of approximately 75 per cent of the generated light. For mounting heights of less than 20 feet these fixtures should always be equipped with frosted bulbs.

For dusty and smoky rooms a dust-tight glass cover is available for the RLM fixture. Another form of this luminaire is provided with white globe inclosing the bulb which may be clear or frosted. This fixture is known as the *Glassteel Diffuser* and provides for better diffusion of light than the RLM Standard Dome, with little loss in efficiency. This fixture is rapidly being recognized as a highly efficient and effective luminaire for industrial purposes where good lighting is essential.

For general use, such as halls, offices, etc., the fixture shown in section 3, Table IV, is quite suitable and in wide use. Care should be taken that the bulb size is within the limits prescribed for the bowl used, or the brightness of the unit may exceed the accepted limit of three candles per square inch and thus become a source of glare and resulting eyestrain.

New shop developments are turning to the problem of noise and methods of reducing the amount of interference resulting from it. This has led to the adoption of various wall treatments having sound-absorbing qualities. For those interested in the light-reflection factors of these materials, the writer suggests writing to the Engineering Department of the General Electric Company, Cleveland, Ohio, for the pamphlet by Powell and Daws on *Light Reflection Factors of Acoustical Materials.*

Lighting Design

The question of how much light is required at the work level to do a certain job effectively, requires a study of the science of "seeing." We know that the human eye is capable of adapting itself to immense ranges of light intensity; e.g., the midday sun on a clear day produces an intensity of as high as 10,000 foot-candles, while in the shade under the same light conditions the intensity still remains close to 1,000 foot-candles. One writer has compared the intensity of sunlight to 10,000 candles placed one foot from a printed page, or

to a 30,000-watt lamp placed in close proximity. From this extreme, the eye quickly adjusts itself to room conditions as low as one foot-candle, 1/10,000 as much as the brightest condition found in sunlight.

The conditions just mentioned represent the extremes. Present standards recommend from 8 to 100 foot-candles for shop and drawing rooms dependent upon the work being done. The writer's experience in checking some 34 industrial-arts shops indicates that 6 to 10 foot-candles approaches the medium in actual practice. Conditions like these do not speak well for the profession's knowledge of good lighting practice. Desirable light intensities have been arrived at through study, observation, and experiment, by illuminating engineers, and their conclusions form a reliable basis of all present lighting comparisons and recommendations. The accompanying list of lighting intensities, Table II, has been compiled from recommendations of the Nela Park Laboratories, Cleveland, Ohio, and *The Franklin Specification for Good Lighting*. The values given represent operating values and not initial installation values which should be higher to allow for depreciation due to dust, dirt, old bulbs, etc.

All lighting authorities seem to agree that *general illumination* should be used as extensively as possible. Such a system has the advantage of reducing the number of outlets needed and therefore the amount of maintenance. Where local lights are needed occasionally, the suggestion has been made that these lights be handled as a special tool and plugged into outlets conveniently placed. Occasionally certain areas need more than average illumination. This condition may be cared for by closer spacing for general lighting fixtures and is sometimes termed as "localized general lighting."

Wall benches are best lighted by a row of RLM Standard Dome Reflectors placed 6 in. in from the forward edge of the bench, spaced on 6- to 10-ft. centers at a height approximating 5 ft. The size of lamps used in these fixtures should be determined by the table of intensities recommended for the nature of the work to be performed. Benches away from the wall are adequately served by the general illumination. Space does not permit further treatment of local lighting in this article since each installation becomes a problem in itself. Suffice it to say that *general illumination* is desirable and essential whether or not local lighting is resorted to.

TABLE II
Recommended Levels of Illumination for Industrial Interiors

Where Used	*Foot-Candles*	
	Recommended Value	*Minimum Value*
Aisles, stairways, passageways	3	2
Bookbinding:		
Folding, assembling, pasting, etc.	8	5
Cutting, punching and stitching	12	8
Embossing	15	10
Clay products and cements: Grinding, filter presses, kiln rooms	5	3
Molding, pressing, cleaning, and trimming	8	5
Enameling	10	6
Color and glazing	15	10
Drafting room	25	15
Electric manufacturing: Storage-battery room	10	6
Coil and armature winding, mica working, insulating processes	20	12
Forge shops and welding	10	6
Foundries:		
Charging floor, cleaning, pouring	8	5
Rough molding and core making	10	6
Fine molding and core making	15	10
Garage—automobiles:		
Storage—dead	3	2
Live	8	5
Repair dept. and washing	15	10
Locker rooms	6	4
Machine shops:		
Rough bench and machine work	10	6
Medium bench and machine work, rough grinding, medium buffing and polishing	15	10
Fine bench and machine work, medium grinding, fine buffing and polishing	20	12
Extra-fine bench and machine work, grinding (fine work)	100	25
Offices:		
Private and general Close work	15	10
No close work	10	8
Paint shops:		
Dipping, spraying, firing	8	5
Ordinary hand painting and finishing	12	8
Finishing	15	10
Printing industries:		
Miscellaneous machines, presses	12	8
Proofreading, lithotyping	15	10
Linotype, monotype, typesetting, imposing-stone, engraving	10	25
Sheet-metal works:		
Miscellaneous machines, ordinary bench work	12	8
Punches, presses, shears, stamps, welders, spinning, fine bench work	15	10
Store and stockrooms:		
Rough bulky material	3	2
Medium or fine material requiring care	8	5
Toilet and washrooms	6	4
Upholstering:		
Furniture	15	10
Woodworking:		
Rough sawing and bench work	8	5
Sizing, planing, rough sanding, medium machine and bench work, gluing, veneering	12	8
Fine bench and machine working,		
Fine sanding and finish	15	10

If we accept these recommendations on lighting intensities, the process of planning of lighting installation should be of interest and value. Planning such an installation makes necessary a decision regarding the relationship between *local* and general lighting. Local lighting is that type employed to illuminate some special spot or limited working area, such as the keyboard and copy on a linotype machine or the music rack in an orchestra. The trend in illumination seemingly is away from this type of lighting except in a limited number of special conditions as just cited.

Planning the Installation

Extremely accurate planning of a lighting installation is a highly technical procedure requiring groundwork in the principles of the illumination and special technical information and data. For practical purposes, however, a very simple and effective plan has been worked out by the Society for Electrical Development. This is available in the form of *The Franklin Specification for Good Lighting*, a copy of which may be obtained without cost from the Electric Association, 20 North Wacker Drive, Chicago, Ill.

It lists five steps in the planning process. They are as follows:

1. Determine foot-candles required (see Table II).
2. Determine "conditions factor" for interior, whether favorable, average, or unfavorable (Table III). For this purpose assume the use of direct or indirect lighting, as the case may be.

5. Locate in Table IV the nearest feasible mounting height as just determined, and further narrow this down to the conditions factor determined in the second step. Then traverse Table IV horizontally to the right until the desired foot-candle intensity is located in the correct fixture section. If no suitable value can be found, go to a closer spacing until a suitable foot-candle value is

ROOM AND MAINTENANCE CONDITIONS

Reproduced from the "Franklin Specification for Good Lighting." By permission of the Society for Electrical Development, Inc.

Proportions of Room	Color of Ceiling and Side Walls	CONDITIONS FACTOR			
		Direct Lighting		Indirect Lighting	
		Maintenance		Maintenance	
		Very Good	Fair	Very Good	Fair
Width approximately four or more times ceiling height	Light	Favorable	Favorable	Favorable	Favorable
	Medium	Favorable	Favorable	Favorable	Average
	Dark	Favorable	Average	Unfavorable	Unfavorable
Width approximately twice ceiling height	Light	Favorable	Average	Favorable	Average
	Medium	Favorable	Average	Average	Unfavorable
	Dark	Average	Unfavorable	Unfavorable	Impracticable
Width approximately equal to ceiling height	Light	Average	Unfavorable	Average	Unfavorable
	Medium	Unfavorable	Unfavorable	Unfavorable	Impracticable
	Dark	Unfavorable	Unfavorable	Unfavorable	Impracticable

Note: The importance of correctly rating the room and maintenance conditions is indicated by observing that in each case for a given lamp size and area per outlet-in other words, for a given number of watts per sq. ft., the illumination may vary as much as three to one, depending upon whether the conditions are favorable or unfavorable.

Table III

3. Select "group" of equipment (see Table IV).

4. Decide mounting height, considering minimum drop from ceiling. With the exception of very high ceilings, 12 feet is a desirable mounting height. Where pulleys, shafting, pipes, etc., are present, it is essential to come below these obstacles.

located. At extreme left is found the required spacing and directly above in the column heading is the required lamp size.

To illustrate more completely the procedure outlined, the following example is given:

Assume a 22 by 54-ft. room with a 11-ft. ceiling, to be used for

LAMP SIZE AND OUTLET SPACING

Taken from "The Franklin Specification for Good Lighting" by permission of the Society for Electrical Development, Inc.

Approximate Spacing	Underside of Reflector to Floor	Conditions Factor	Section 1 RLM Standard Dome — Fairly wide spread of light. No upward light to relieve harsh ceiling contrast. Minm. drop from ceiling 15"			Section 2 Glassteel Diffuser — For high quality industrial lighting. About 7% of light directed toward ceiling for natural cheerful working conditions. Minm. drop from ceiling 18"			Section 3 — For General Use. Recommend diameters: 100-150 watt -- 12", 200 watt 14", 300 watt 16". Minm. drop from ceiling 24"		
			Average Foot-Candles			Average Foot-Candles			Average Foot-Candles		
			150 watt	200 watt	300 watt	150 watt	200 watt	300 watt	150 watt	200 watt	300 watt
7 3/4' x 7 3/4'	7' 6"	Favorable	15-18	21-26		13-16	18-23		10-14	15.22	
		Average	11-15	16-21		10-13	14-18		7-10	11-15	
		Unfavorable	9-11	13-16		8-10	11-14		4- 6	7- 9	
8 1/2' x 8 1/2'	8' 6"	Favorable	13-16	18-22		11-14	15-19		9-13	13-19	
		Average	10-13	13-18		8-11	11-15		6- 9	9-13	
		Unfavorable	8-10	11-13		7- 8	9-11		4- 6	6.5- 8	
9' x 9'	8' 6"	Favorable	11-14	15-19		10-12	13-17		8-11	11-17	
		Average	8-11	12-15		8-10	10-13		5-8	8-11	
		Unfavorable	7- 8	10-12		6- 8	8-10		3.5-5.0	6- 7	
9 1/2' x 9 1/2'	9' 0"	Favorable	10-12	14-17		8-10	12-15		7-10	10-14	17.24
		Average	8-10	11-14		6- 8	9-12		5- 7	7- 9	11-17
		Unfavorable	6- 8	9-11		5- 6	7- 9		3- 4	5- 6	7-11
10' x 10'	9' 6"	Favorable	8-10	12-15	21.26	7- 9	11-13	18-23	6- 9	9-12	15-21
		Average	6- 8	10-12	16-21	5- 7	8-11	13-18	4- 6	6- 8	9-15
		Unfavorable	5- 6	8-10	13-16	4- 5	6- 8	11-13	2.5-4.0	4.5- 5	6- 9
11' x 11'	10' 0"	Favorable	7- 9	10-13	16-22	6- 8	9-11	15-19	5- 7	8-11	13-19
		Average	6- 7	8-10	14-18	5- 6	7- 9	11-15	4.5-5.0	5.5- 7	8-13
		Unfavorable	5-5.5	7- 8	12-14	4- 5	5- 6	9-11	2.5-3.0	4-4.5	6- 8
11 1/2' x 11 1/2'	10' 6"	Favorable	6- 8	9-11	15-19	5- 7	8-10	13-17	5- 6	7- 9	11-16
		Average	5- 6	7- 9	12-15	4- 5	6- 8	10-13	3.5-4.5	5- 6	7-11
		Unfavorable	4- 5	6- 7	10-12	3- 4	4.5-5.5	8-10	2- 3	3.5- 4	5- 7
12 1/2' x 12 1/2'	11' 6"	Favorable	5- 7	7- 9	13-17	4- 6	6.5- 8	12-15	3.5-5.0	6- 8	9-14
		Average	4- 5	6- 7	10-13	3- 4	5- 6	9-12	3.0-3.5	4.5- 5	6- 9
		Unfavorable	3.5-4.0	5- 6	8-10	2.5-3.5	4- 5	7- 9	1.5-2.5	3-3.5	4- 6
13 1/2' x 13 1/2'	11' 6"	Favorable	4- 6	6- 8	11-14	3.5-5.0	6- 7	10-12	4- 5	5- 6	8-11
		Average	3.5-4	5- 6	8-11	3.0-3.6	4- 5	7-10	2.5- 3	4-4.5	5- 8
		Unfavorable	3.0-3.5	4- 5	7- 8	2.5-3.0	3.5-4.0	6.5-7.5	1.5- 2	2.5- 3	3.5- 5
14 3/4' x 14 3/4'	12' 6"	Favorable	3.5-4.0	5- 7	10-12	3.5-4.0	5- 6	8-10	3- 4	4- 5	7-10
		Average	3.0-3.5	4.5-5.5	7-10	2.8-3.5	3.5-4.0	6.5- 8	2.0-2.5	3.5- 4	4- 7
		Unfavorable	2.5-3.0	3.5-4.0	6- 7	2.0-2.5	3.0-3.5	5.5-6.5	1.0-1.5	2-2.5	3- 4
15 1/2' x 15 1/2'	13' 0"	Favorable	3.0-3.5	4- 6	8-10	3.0-3.5	4- 5	7.5- 9	2.5-3.5	3.5- 4	6- 9
		Average	2.5-3.0	4-4.5	6- 8	2.5-3.0	3- 4	6- 7	1.5- 2	3-3.5	3.5- 6
		Unfavorable	2.0-2.5	3.5-4.0	5.5-6.5	1.5-2.0	2.5- 3	4.5-5.5	1-1.5	1.5- 2	2.0-3.5

Table IV

general woodworking. This is a room size frequently used. The artificial lighting will be designed to be sufficient unto itself since this condition insures a minimum intensity throughout the room regardless of the conditions of natural lighting at any given time. The ceiling and upper walls are painted a creamy white. It has been decided to use a direct lighting system, well maintained.

Step one in the design of a lighting system for the conditions given consists in determining the intensity of light needed for the work by referring to Table II. Since this shop is to be used for general woodworking we find that an average recommended intensity for the various types of work to be performed should approach 12 foot-candles or better.

Step two consists in determining the effect on lighting of the various factors, such as color of walls and ceiling, size of room, condition of maintenance, etc. This is conveniently done by referring to Table III, as prepared by the Society for Electrical Development. This element in lighting design is known as the "conditions factor." And for the room in question we find the "conditions factor" to be "favorable." It will be noted that the room proportion, height to width, is approximately 1 to 2, walls and ceiling are light in color, direct-lighting fixtures are being used, and maintenance is very good.

Step three consists in the selection of equipment. The nature of the work in our assumed problem calls for a fixture possessing good diffussion, fairly wide spread of light, ease of maintenance and a relief from sharp contrasts between lower portions of the room and ceiling. Since the efficiency of the luminaire is always a factor, the one selected should be the best possible within the limits prescribed. Since high diffussion is not essential the Glassteel Diffuser shown in Table IV, Section 2, will be most suitable.

The fourth step consists in determining the mounting height. Authorities seem to agree that a minimum height of 12 ft. from bottom of fixture to floor be used wherever possible. In the conditions used for illustration, it will be noted that the ceiling height is only 11 ft., hence the fixture must be placed as close to the ceiling as possible. Referring to Table IV, Section 2, we find the minimum drop from the ceiling, for the fixture selected, is 18 in.; therefore, the distance from fixture to the floor in this instance will be only 9 ft. 6 in.

Step five consists in determining lamp size, and the spacing of the fixtures for the factors already determined. This is done by again referring to Table IV. Under the column headed "Distance from Underside of Reflector to Floor" is found the mounting height of 9 ft. 6 in. This is a fixed condition which other factors must accommodate. In the column to the left, just opposite the mounting height of 9 ft. 6 in., is found 10 ft. given as the spacing of the units. On the right-hand side are listed the three possible "condition factors," selecting the one listed as "favorable," move to the right to the columns under Section 2, and note the intensities resulting from the various sizes of bulbs that might be used. Under the column headed 200 Watt, we find an average of 11–13 foot-candles and under 300 Watt an intensity of 18–23. The 200-watt bulb gives an intensity approximating rather closely the 12 foot-candles decided on in step one, while the 300-watt bulb will provide a better and more desirable illumination.

Step six concerns itself with the actual layout. Examination of the layout shown in Figure 5 reveals that for uniform spacing, the

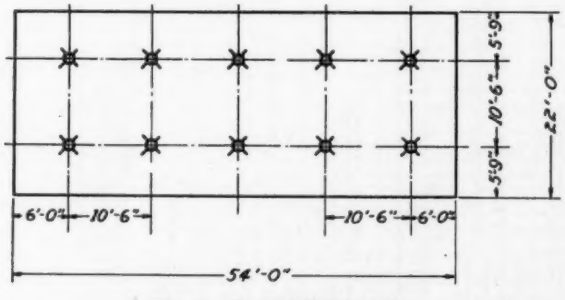

Fig. 5. General lighting plan

luminaires must be placed on 10 ft. 6-in. centers. The distance from the lights to the wall should be approximately one half the distance between the fixtures.

Thus the lighting for this room calls for 10 Glassteel Diffuser luminaires equipped with 200- (or better 300-) watt bulbs, arranged in two rows of 5 each, spaced 10 ft. 6 in. between centers. Occasionally the spacing of fixtures in shop rooms with bayed ceilings must be adapted to the arrangement and size of the bays. Several possible arrangements may be worked out to provide symmetrical appearance and uniform light distribution for varying conditions. When ceilings are greater than 12 ft. in height, symmetrical spacing with regard to bays becomes less difficult because of the latitude gained through the possibility of varying the mounting height of the luminaires.

Maintenance of the Lighting System

No discussion of illumination can afford to neglect the problem of maintenance, for any lighting system no matter how effective when first installed may become entirely inadequate if not properly cared for. A bulletin by the Westinghouse Electric & Manufacturing Co. on *Industrial Lighting* states that a new lighting system is 25 to 50 per cent more effective than it will be after a period of use. A bulletin, *Getting the Light You Pay For,* published by the National Lamp Works of Nela Park, Cleveland, Ohio, states that there are six principal causes of lighting depreciation as follows:

1. Dirty reflectors.
2. Darkened walls and ceilings.
3. Lamps of poor quality.
4. Empty sockets and unobserved burn-outs.
5. Undervoltage burning of lamps.
6. Improper combination of lamp and reflector.

This same bulletin cites a case in a machine shop where a fine installation of Glassteel Diffuser luminaries are used. A thorough cleaning of the units revealed, by actual measurement, that they had been delivering only about one fifth of their rated capacity, or 2½ foot-candles instead of 12½, which meant a waste of about 80 per cent in operating cost alone.

A further example of the value of good maintenance is found in the National Lamp Company's bulletin No. 35, *The Lighting of Offices and Drafting Rooms.* It reads as follows:

"Anderson records the following results of investigating a complaint of inadequate office illumination where the system consisted of indirect silver-glass units properly located":

	Foot-Candles	*Per Cent*
Before cleaning reflectors	3.75	100
After cleaning reflectors	4.68	125
Cleaned reflectors — new lamps	5.26	140
Repainted ceiling	6.78	181

"The original finish of the ceiling was a yellowish cream paint on sand-surfaced plaster. This had become somewhat blackened through two years of service. It will be noted the refinishing of the ceiling with paint of good reflecting characteristics and of somewhat lighter tone than that previously used, resulted in an increase of 30 per cent useful light. The improvement of 25 per cent by wiping out the reflectors decided those in charge of the building on a weekly instead of a monthly cleaning schedule and on refinishing at definite periods all rooms where indirect lighting was employed."

It should be noted that the example just given is one in which indirect lighting was used. In the case of direct-lighting units, the ceiling becomes much less of a factor in maintenance.

Bulletin No. 42, *Factory Lighting Designs,* published by the National Lamp Works, suggests the following cleaning schedule for industrial shops:

Suggested Cleaning Schedules
for Direct-Lighting Systems

Characteristic of Location	*Interval in Days if Units Are Wiped Out*	*Interval in Days if Units Are Thoroughly Washed*
Very dirty	3	5
Dirty	7	10
Average	15	20
Clean	30	40

Where dry dust and smoke are encountered, the lighting

units may be cleaned fairly well by wiping with a dry cloth. When the dirt is of a greasy or oily nature, however, they should be washed with warm water and soap. This treatment is desirable at varying intervals for all conditions. Keep empty sockets filled and old lamps renewed. Some bulbs show a marked decrease in brightness over a long period of use and may be profitably renewed although they still give light. A teacher may be pardoned for a lighting installation beyond his control but there is little excuse for any system, however inadequate, poorly maintained.

This brief article has attempted to give a picture of the problem of lighting, recent lighting developments, the design of a general lighting system and the need for adequate maintenance. Nothing has been said about the problem of light as it bears on the eyesight of people. The fact, however, that 25 per cent of the people need corrective eye measures may indicate the importance of such a topic. The entire theory of illumination might, and probably should, be studied and understood by all responsible for lighting and lighting equipment. For the purpose of further study by those interested, the accompanying selected bibliography is supplied. With the exception of Luckiesh's book, *Light and Work*, and the *Transactions of the Illuminating Engineering Society*, all the references listed may be obtained without cost.

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Senior-High-School Electricity

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This course outline has been found helpful in the school where it was originated. It may be found equally helpful elsewhere.

Can the teaching of a general course in electricity be justified in the senior high school? If so, what type of instruction should be employed, and what should be the nature of the course? These are questions which bring forth frequent discussions at present in the rearrangement of schedules to meet the current demands for practical courses in the senior-high-school curriculum. The purpose of this article is not to answer directly these questions but to explain briefly what has been accomplished and what is now being done along these lines in the senior high school at Marshalltown, Iowa.

Marshalltown is a typical industrial center of about 20,000 people located in the midst of a highly agricultural region. In 1926–27 it undertook and completed the construction of a $400,000 senior-high-school building. The basement of the south wing of this building was fully equipped for the development of a modern industrial-arts plant. Washbasins, power inlets, storage rooms, and lighting were all conveniently placed. Removable partition walls and concrete floors covered with treated wooden bricks were added conveniences.

Here in the autumn of 1927 was begun a course in general electricity with a group of about 35 junior and senior boys.

Our objectives in the beginning were somewhat vague, but from year to year they became more clear, and we think at least, that we have a few definite goals in view at the present time. They are listed below:

1. To develop a better understanding and appreciation of the fundamental laws and principles of electricity.
2. To further develop the idea of home mechanics with a better understanding of, and more skill in, manipulating and repairing the common electrical devices in everyday use.
3. To develop a better understanding of the trade rules and regulations of the electrical industry.
4. To develop an understanding and appreciation of the electrician's job.
5. To develop skill in constructing and assembling experimental apparatus.
6. To develop creative ability.
7. To satisfy the curiosity concerning electrical phenomena and experimentation which is always present in every normal boy of high-school age.

As general objectives we have constantly held up and adhered rather closely to the seven objectives outlined by the National Educational Association; and after five years' experience with our two electrical courses, we believe that these general objectives may be applied to a practical electrical course in the senior high school as well as to any other academic or industrial-arts course in that institution.

In the brief outline of the course given below the "doing items" are listed in the left-hand column and the "knowledge items" in the right. This outline applies to the first-year non-vocational course and not to the advanced course.

1. Construct a pith-ball electroscope; test various charges.	1. Knowledge of static electricity.
2. Construct magnetic compass; plot magnetic field.	2. Principles of magnetism.
3. Set up various electrical circuits.	3. Elementary principles of current electricity.
4. Construct electric cell, a simple dynamo, and produce electricity with heat.	4. Principles used in producing alternating and direct current.
5. Connect commercial instruments in circuit to measure current, voltage, and power.	5. Elementary conceptions of electrical units.
6. Construct electromagnet; determine effect of ampere-turns and attracting power.	6. Principles of electromagnetism.
7. Construct galvanometer.	7. Principles involved in the construction and operation of electric meters.
8. Take apart and study commercial meters.	8. Commercial applications of principles studied.
9. Construct an induction coil.	9. Principles of electromagnetic induction; uses of coil.

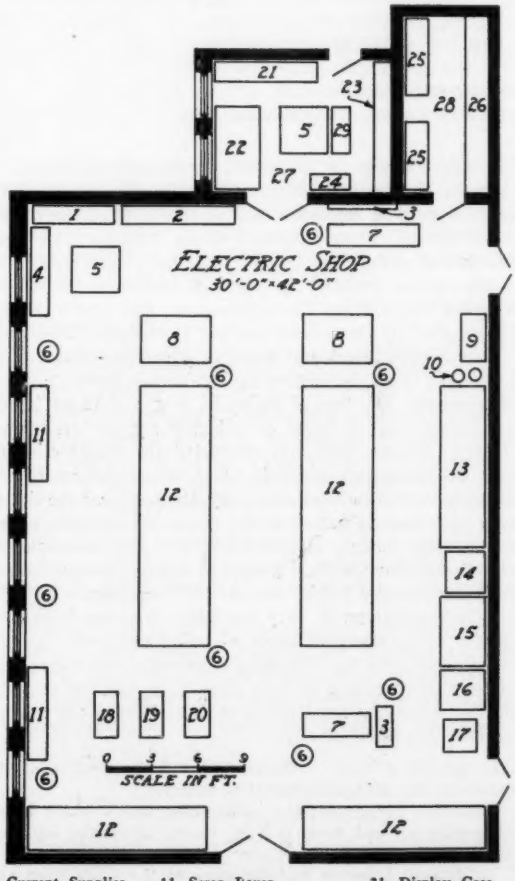
10. Construct and use a test board.	10. Ohm's law; methods of connecting meters in circuit; short circuits; grounds.
11. Construct a soldering iron.	11. Heating effect of current.
12. Test soldering iron for short circuits and grounds with test board. Calculate resistance of element and cost of operating.	12. Application of Ohm's law; calculating cost of electric power.
13. Tin the soldering iron; make and solder various types of electrical joints.	13. Importance of electrical joints; principles of soldering them.
14. Repair electrical heating devices, flatirons, heaters, toasters, etc.	14. Principles involved in the construction of commercial devices applying the heating effect.
15. Construct small storage cell and rectifier; charge cell.	15. Chemical effect of electric current, electrolysis, and electroplating.
16. Tear down and rebuild a commercial storage battery; repair or study a commercial charger; charge battery with it.	16. Commercial applications of chemical effect; principles involved in rectifying alternating current.
17. Construct push button, electric bell, and bell transformer; connect in circuit, test, and use.	17. Magnetic effect of current; electric switches.
18. Repair commercial bells, transformers, and switches.	18. Commercial applications of principles studied.
19. Construct a small electric motor.	19. Principles involved in motor construction and operation.
20. Rewind a small commercial motor or generator.	20. Commercial applications of principles.
21. Construct crystal detector and audio amplifier.	21. Radio principles and circuits.
22. Assemble 1-tube a.c. receiver.	22. Principles involved in a.c. circuits.
23. Repair or study a commercial radio.	23. Interpretation of commercial circuits.
24. Construct oscillator; use to learn and practice code.	24. Principles used in wireless telegraphy.
25. Construct or assemble a short-wave receiver; use to pick up amateur code.	25. Principles used in short-wave reception; interpretation of short-wave circuits.

The foregoing outline reveals the fact that emphasis is placed on both technique of performance and the acquiring of facts and principles. The aim is to stress them both about equally. Individual instruction plays an important rôle, and the instruction-sheet method is employed almost exclusively. No attempt is made to keep the students working together. As soon as a student has completed a job, the instruction sheet with the constructed device is presented to the instructor for approval. At this time the instructor makes the necessary corrections and gives any individual instruction which he deems necessary. When the sheet is fully approved, it is placed in the files and the student is given the next instruction sheet. Many of the articles constructed by the student are used by him later in the year, and each student is encouraged to keep these articles in good shape for the annual exhibit at the end of the school year.

Ample supplies for the courses are purchased by the school board during the summer months. At the beginning of the year the student buys a one-dollar supply ticket which usually lasts through the first semester. When he gets supplies to construct an article for himself, this ticket is punched for the value of the supplies. If a student is unable to purchase a ticket, a fund is available whereby he may receive one free of charge. The cost of supplies for the courses runs from $150 to $200 annually; but as 90 to 100 tickets are sold each semester, the course is almost self-supporting so far as supplies are concerned.

In the autumn of 1927, when the course was begun, the shop equipment was somewhat meager, but each year various devices have been added until the shop is very well equipped at the present time. Much of the equipment, such as test benches, switchboards, meter panels, coil winders, and an electric oven, have been constructed by students of the advanced classes. Several of the motors which are in use in the shop have also been rewound by these students. The purchased equipment includes two machine lathes, grinders, drill press, lead-burning equipment, electric- and oxyacetylene-welding equipment, all types of alternating- and direct-current meters, a motor-generator, and a kit of hand tools and measuring instruments. The outlay for cost of this equipment would probably run from $1,500 to $1,700. Radio, electric, and automobile dealers of the city have aided us materially in this work by contributing scrapped electrical equipment, such as radios, transformers, motors, generators, telephones, electric fans, flatirons, heaters, toasters, storage batteries and discarded house meters. This equipment has been of very great assistance in studying the commercial applications of electrical principles and methods of repairing commercial devices. The shop also is equipped with a complete electrical library which contains electrical guides, recent texts on electricity and radio, and current electrical and radio magazines and publications. The students have access to this library while working in the shop and are encouraged to look up references on electrical principles and problems as they encounter them in their practical work.

The shop accommodates from 30 to 36 students and the organization of each class is such that the time spent by the instructor in detail work is reduced to a minimum. A toolkeeper, a machine foreman, and a foreman for each of



1. Current Supplies
2. Tool Rack
3. Lathe Tools
4. Magazine Case
5. Instructor's Desk
6. Waste Receptacles
7. Machine Lathes
8. Test Bench
9. Washbasin
10. Oxyacetylene Torch
11. Scrap Boxes
12. Workbenches
13. Vise and Welding Bench
14. Three-Phase Test Bench
15. Storage Battery Bench
16. Glue and Enamel Bench
17. Electric Oven
18. Grinder
19. Motor Generator
20. Drill Press
21. Display Case
22. Radio Bench
23. Bookcase
24. First-Aid Case
25. Storage Racks
26. Storage Shelves
27. Office
28. Storage Room
29. Filing Cabinet

the four workbenches are appointed at the beginning of each semester. Early in the year the instructor gives the machine foreman instructions on operating each of the machines. It then becomes the duty of this foreman to instruct other students in the operation of these machines as the need arises. It also is his duty to see that the machines are kept in order and properly oiled at all times. The other foremen are likewise held responsible for their respective duties. At the beginning and end of each class period each foreman reports to the instructor anything that is not in order. Ordinarily the students work in groups of from two to four. Each group constructs a tool box in which they keep small individual tools, such as hammers, pliers, and screw drivers. They also keep in this box the smaller devices which they construct and are to use as they progress in the course; for example, soldering iron, test board, and small transformer. At the end of each class period these boxes are placed in the storeroom on shelves provided for them. The students are given three minutes at the beginning and end of each 80-minute period for getting out and storing away their boxes and projects.

The grading is done and recorded by the instructor on the progress chart shown in Figure 1, when the completed projects and instruction sheets are approved. Ordinary cross-ruled sheets may be used for this progress chart. A check mark, as shown, denotes average work on the part of the student, a plus denotes above average and a minus denotes below average. When a student has completed a series of lessons, he is given an individual or small group test on that series. The test is on a sheet similar in appearance to an instruction sheet. When the test is scored, the grade is recorded and the test sheet is filed under the student's name with his completed instruction sheets. The student also is asked to keep an individual time card to check with the instructor's record at the end of each grading period. This time card shows the number of minutes spent on each project and instruction sheet and is very effective in making the student conscious of how his time in the shop has been spent.

Thus far we have discussed only the first-year course which is a prerequisite for the advanced course. The advanced class usually is made up of from twenty to thirty senior boys who plan to go into some branch of electrical work. The student

Name	Instruction-Sheet Number									
	1	2	3	4	5	6	7	8	Test	Grade
John Rice									88	C
William Foster									90	B

Progress Chart

is free to choose the phase of work which he desires to follow. Auto ignition, house wiring, radio, amateur radio, motor and generator, switchboard construction and operation, telephone, transformer, storage battery, electric refrigeration, stage lighting, and talking-picture operation are some of the phases which have been chosen by these students in the past.

When possible, the advanced students are allowed to enter employment in an electrical occupation or shop for part time. They are given credit for this kind of work. Each student is encouraged to visit all electrical plants and establishments in which work, related to his chosen phase of work, is done. He must, of course, make written reports on all of these visits. At least once during each month the class as a group visits some industrial plant to observe how electricity is applied in that plant. These observations are of a general nature and are planned so that students taking any phase of the work may receive something beneficial from the visit. Discussion of the observations made and questions on principles involved usually take up the class period the day following the trip.

A large majority of these advanced students after completing this course either find employment in some electrical industry or enter college to take up electrical engineering. Many find employment in the city for a year or two and then take up the college course.

The results obtained with these courses for the past four years lead us to believe that both a general and an advanced course in practical electricity should have a place in the senior-high-school curriculum.

Some typical instruction sheets will follow at a later date.

Electrical Shop, Senior High School and Junior College Building, Marshalltown, Iowa

INDUSTRIAL ARTS *and* VOCATIONAL EDUCATION

J. J. Metz, Editor

Balancing the Budget

Many recommendations have been offered from time to time on the subject of how governmental costs could be reduced. While much serious thought has been spent on this most difficult problem, it is quite understandable that the human trait of taking the easiest way out has so far produced only recommendations which might produce results, but which might probably also do much harm.

Americans have been led to lean more and more heavily upon the government for many things. As need after need arose, governmental agencies, for taking care of additional functions, have multiplied so that in the present crisis it is difficult to decide between the absolutely necessary and the merely worth while.

Many of these governmental functions were placed in the hands of persons or committees shrewd and powerful enough to so organize that they can successfully withstand any attempt at reducing the customary funds required to carry on their work, even though that might be the advisable thing to do in the present emergency.

Unfortunately, the school, which has a very definite and very difficult job to perform, and which, though forced at times into politics, is not so organized. It is therefore unable to cope with politicians who can make a junket for the study of the wild life in a certain region of this country important enough to squander thousands of dollars, while the education of the youth of the land is so hampered for lack of funds, that schools must be closed, teachers laid off, and the future welfare of our country jeopardized.

Some of the articles on education which recently appeared in the *Saturday Evening Post* must have given hundreds of thousands of well-meaning and hard-working teachers a bitter laugh. There may be some Crœsuses in the teaching profession and undoubtedly there are some teachers who are snobs, but a trip to Bermuda surely must appear like a chimerical phantasm to the teacher from Chicago and elsewhere, who not only had to go through the nightmare of bank failures, but also had to subsist while wages were withheld for months and months. In the meantime, they had to stay on the job. They did not have the wherewithal to clothe themselves properly, nor did they have the food which they would ordinarily think necessary, and yet some writer, who, no doubt, has never gone through these harrowing experiences, calmly makes it appear as though they were snobs who have not felt the depression and who therefore do not realize the miseries of others.

No one, of course, would want to argue for one minute that savings could not be effected in the school field. Schools, too, have done things in the period of prosperity that ought now during times of need to be suspended until money can be more freely obtained. There is an old German proverb which says *Man muss sich nach der Decke strecken,* which might be translated "One must adapt himself to existing circumstances," and the shop teacher must bear that in mind. Not only must he organize his work so that he can handle larger classes efficiently, but he must also plan it so that more inexpensive materials will answer the purposes of instruction. Naturally, the things made of these materials may not measure up to the standard of products previously made, but probably this can be overlooked because valuable lessons of conservation can be incorporated in the work. Now, where there are so many families who have been deprived of their last piece of furniture because installments could no longer be paid, old ideas of thrift can be revived. Lumber salvaged from packing crates and boxes can be worked up into acceptable benches which will serve for chairs, kitchen tables may be made, and cupboards, dressers, and other pieces of household furniture manufactured. Yet almost every bit of instruction that was possible on the higher priced woods can be brought into play on this salvaged material. Industrial shops which now stand idle will probably be glad to furnish scrap material accumulated in more prosperous times for the school machine shop. The lowly tin can still possesses many possibilities. Printing plants may be approached to furnish waste and scrap paper for the practical work in the printshop. The junk dealer may probably be persuaded to furnish parts of wrecks from old and modern cars for the work of the automobile department. The tinsmiths and sheet-metal factories also produce scrap which they may be willing to contribute. With planning and ingenuity teachers of other subjects also may find inexpensive ways of carrying on their work.

Naturally, the dresser made out of old crate lumber will not look as finished as the one formerly produced out of black walnut or oak, yet it will answer the purpose for the present. Nor can this work be looked upon with disfavor by the manufacturers and dealers. There is no possibility at present, of selling good furniture to the families who would make use of household articles manufactured out of salvaged material. There need be no fear either that the makeshift furniture will be used any longer than is absolutely necessary, for with the resumption of industrial activity one after another of these articles will be replaced.

In the meantime, however, the shop teacher has made possible the continuance of his work in the school, has helped in making the present times bearable, has appreciably aided in balancing the budget, and thus has done his share in fighting for a victory over the conditions which make the conducting of the school shop so difficult in the present crisis.

Washington and Lincoln

The month of February each year gives the shop teacher a special opportunity to call the attention of his classes to those two sterling cthracters of whom America is so justly proud — Washington and Lincoln. It might, of course, be called duplication to have a Washington and Lincoln celebration in the auditorium, another in the history or English class, and still another in the school shop. There is, however, so much appeal in the lives of both of these great men that reference to their careers may be made in more than one course without really exhausting the possibilities.

The lives of both of these men show many similarities. Both of them had to steer our country through seriously troublesome times. Both of them met vilifications and criticisms steadfastly and with fortitude. Ambitious, no doubt, both of them were, but their ambitions did not becloud their better judgment, nor did the plaudits of their fellow men make them forget their duty to the citizens of their country.

While the one came from almost aristocratic stock, and the other was reared in near poverty, yet the expressions of what each deemed his duty indicate that there was little if any difference between the loftiness of the ideals of the one and those of the other. In this respect, one must really marvel at Lincoln. His antecedents, and his associates until well into manhood, were men of little education, if they were not entirely unlettered. Yet many of his later messages and his written speeches today are looked upon as classics.

Both, however, are shining examples of men, who, relying on Providence, calmly strove and stood for that which they believed the right. Willing to listen to the opinions of others, they nevertheless masterfully insisted on working out their solutions as their own judgments dictated. Willing also to give credit where it was due, they were not afraid to shoulder blame. They were statesmen, soldiers, leaders of victorious armies, and rulers of a nation, but both of them also were practical men who had experienced the hardships of manual labor. They knew what the man who labors has to contend with.

It would be a pity indeed if the shop teacher did not make use of the lives of these two great Americans to inspire his students, and to instill in them an admiration for the sterling virtue which both possessed.

What Will the Future Bring?

Many shop teachers, working much harder today than they did in the past, although their income may have been appreciably reduced, are frequently troubled by thinking of their courses in connection with the training which the future seems to require. Technocrats and others who have with their doleful oracular voices cast gloom and doubt about the functions of the work of industrial arts and vocational education in the future, have made many prophesies, and have said much about the uselessness of our present methods of procedure. Yet, this fear need not unduly distress the shop teacher. The conscientious effort of the schools to do whatever is required of them, will help make adjustments as they become necessary. Just as there is a process of evolution in industry and economics, so there is a process of evolution in the work offered by the school. The present method of teaching shopwork in the school may not be, and probably is not, the best way of conducting the work, yet even in this time of emergency it is doing wonderful work for many of the unemployed. For the wiser of these who take advantage of the adult educational courses offered, the school is not only a source of knowledge but also an inspiration and a means of maintaining some semblance of morale.

Taking for granted, then, that the shopwork in the schools will adapt itself to the needs and requirements of the times as these become evident, there is another matter which really ought to trouble the shop teacher. At no other time in history were there so many people partly or wholly supported by public or private philanthropy. Families that have always been self-supporting have been thrown suddenly into a position where it is imperative for them to accept help from others. The breakdown of banks and other financial institutions have made beggars of many who prided themselves on their thrift. The man who never saved a penny, but spent all of his earnings without any regard for the future suddenly found himself to be no worse off than the man who had carefully saved as much as he could. Both the thrifty, provident man and the spendthrift in many instances, must now accept charity. Such conditions are apt to react detrimentally on the thinking of the young who are living through the present economic upheaval.

It is up to the teacher, and probably the shop teacher is in a better position than anyone else to straighten out the student on these vital questions. The right ideas about thrift must be emphasized continually. The value of self-respect, of honesty, stability, and the value of labor must be dwelled upon. The man who has lost a job through no fault of his own, but has now found out how easy it is to get along on the provisions, rent, light, and heat received from a public or private social agency may have had his ideas about the value of the old-fashioned virtues of thrift, self-respect, independence, etc., seriously warped. The boy, whose father argues that there is no reason for accepting a job at small wages so long as one can get sufficient aid to support a family without making any personal effort, is in a position where he needs a great deal of guidance. These are new problems that the depression has brought about. Such erroneous thoughts, and the acquiring of habits of idleness and shiftlessness need combating, and the best method of accomplishing the desired ends is worthy of the shop teacher's most serious thought and planning. Now is the time to take care of the solution of these problems. Worrying about the future will help little; there is too much to be done right now.

Twelve Years of Cooperation

Homer J. Smith

Professor of Industrial Education, University of Minnesota, Minneapolis, Minnesota

This short historical sketch graphically depicts what may be done if educational institutions work together in achieving a definite goal.

COOPERATION has always been one of the key words, and one of the basic requirements of real vocational education. There has always been less of "planning and working together" at the college level than below it; and, there are marked contrasts among the newer fields below college grade as to the number and clearness of examples. Someone desiring to make a distinct contribution to the literature of education can make no happier choice than to review, in some detail, a selected and varied set of the most effective plans of coöperative training.

This paper is a record of one such joint-effort scheme, a project long continued and still in operation. We are concerned here with the relationships, in industrial teacher-training, between the William Hood Dunwoody Industrial Institute and the department of industrial education in the University of Minnesota.

About 1920, an outline of coöperation, both brief and tentative, was prepared by Dr. Charles A. Dunwoody, and Professor Arthur F. Payne, of the university. The outline concluded with the statement that, "The purpose and spirit of this agreement is that both institutions may coöperate in every possible way in the development of all forms of trade and industrial education in this part of the country." Realization has been so generally satisfactory that the plan may well be approximated wherever similar needs and conditions exist.

In the formal agreement each institution recognized its distinct function and accepted the opportunity of mutual helpfulness. One was to prepare industrial teachers, general and vocational; the other was to train numerous kinds of mechanics and technicians; and the two were to exchange assistance on these projects. It is a pleasure for one who has been concerned with the agreement, almost from the beginning, to set forth some of its working detail and its quantitative results.

Three administrative officials of the institute (Charles A. Prosser, Ralph T. Craigo, and M. Reed Bass) have assisted at the university for parts of each year and each summer, by conducting courses of the lecture, textbook, and discussion type. *During the period they have combined to bring to about fifteen hundred college students their special experiences and viewpoints.* They have been particularly effective in passing first-hand knowledge of the changing administrative and supervisory program of their institution. In no better way could our students have gained the concept and learned the practice of continually studying local demands and adapting training to them. These fifteen hundred students have been in touch with strong proponents of certain current theories and with a real laboratory of trade preparation and upgrading. The courses most frequently presented by these men have borne titles as follows: Analysis, The Day Industrial School, The Evening Industrial School, Part-Time Education, Problems of Vocational Education, etc.

Hundreds of university students in training for industrial teaching, paying all fees except a small deposit to the university, have pursued shop and drawing courses at the institute and have observed the teaching methods and devices there in use. This type of credit work has been accepted day and evening, throughout academic years and summer sessions, toward degree and special-certificate requirements. *The total of individuals who have chosen so to attain the necessary manipulative and related credits is beyond five hundred. At the close of the fall quarter, 1932–33, the total Dunwoody contact of university students stands at 777 course enrollments.* These are distributed among subject fields as follows, no account being taken of the excellent possibilities for pursuing selected units within fields.

Enrollments and Fields

128	Mechanical drafting	25	Bldg. const. drafting
125	Sheet metal	17	Welding
115	Printing	8	General shopwork
95	Electricity	35	Miscellaneous (power lab., baking, show card, radio, paper hanging, general metal, building estimating, etc.)
85	Machine shop		
67	Auto mechanics		
48	Building construction		
29	Related drafting		

(Total 777 enrollments)

Courses completed have been recorded at the university on the basis of one quarter-credit for each 24 clock-hours of instruction. After individual counsel some students have used their Dunwoody time for extensive and others for intensive preparation within the list of industrial subjects commonly taught in schools.

It should be noted that shop and drawing courses are available in the engineering colleges and in a general shop wholly under the management of the department of industrial education. Students pursuing the four-year curriculum are required to begin their work in the departmental shop and may then pass to engineering or to Dunwoody courses for the remainder. All other students choose between engineering and Dunwoody from the first and many divide the desired courses as they wish. Younger men, regardless of their hopes as to ultimate level or type of teaching service, are urged to take courses representative of the widest possible variety of trade fields and specialties.

The 777 enrollments have varied in number of credits and therefore in the number of hours specified in each. It will be noted that the modal practice is a two-credit of a 48-hour enrollment. This is not by chance. The university operates on the quarter plan and the institute by semesters, making it convenient for a student to accumulate 48 hours during 12 weeks by reporting on two evenings or for two half days of uninterrupted work. In summer sessions of six weeks' length a full 8-hour day has commonly been scheduled.

Credits and Enrollments

Credits	*Cases*	*Credits*	*Cases*	*Credits*	*Cases*
1	39	5	28	9	3
2	486	6	7	10–11–12	1 each
3	116	7	2	(Some few mixed-number cases	
4	90	8	3	included as without fractions)	

These 777 cases or enrollments, with their varying durations, bring the total of booked credits to 1,999 and the total hours of instruction to 47,976. Approximately two thousand quarter-credits have thus been earned by students under this plan and Dunwoody has served to the extent of approximately fifty thousand hours of instruction. This will, doubtless, be as interesting and surprising to institute officials as it is to the writer and will afford a rather specific measure of their service.

As has been written, many students have earned this credit in the regular meeting of curriculum or certification requirements. Many more, particularly those employed full time in the schools of the Twin Cities and towns near by, have done

work in the evening as an aid on present assignments or in preparation for better positions. This constant refreshment of and addition to training is one of the fine and unmeasurable results of the plan here described. It has always been a matter of great satisfaction to note the number of our industrial teachers who pursue shop and drawing courses beyond the maximum for credit logically set by the university. There has been, through the years, the possibility for home teachers and for summer session students drawn from a wide area to procure some subjects not offered in the university proper and many standard subjects under conditions dissimilar to those of campus teaching.

The agreement guarantees to the faculty men of Dunwoody the privilege of university courses under full excuse from the regular college tuition. There has been a rather generous acceptance of this offer, particularly in view of the teacher-training program provided by the institute for its own instructors. *Several of the Dunwoody faculty have earned the bachelor's degree under this plan and there are now two of our masters among them.*

There are, then, three main features of the coöperation: Certain Dunwoody men present campus courses; university students go to Dunwoody for shop and drawing courses; and Dunwoody instructors enroll at the university for such instruction or credit as they may desire or find it convenient to arrange.

To go beyond this point in explanation would seem to be an unwarranted presumption upon the time of the readers of this periodical. There may be some who would appreciate more detail and they are invited to ask such questions as may occur to them. Certain items of this kind come to mind and there may be many others: the possibility of special trade examinations, the printed forms used for enrollments, the translation of credit values, the dovetailing of shop units from all sources, comparative grading, coöperation in course planning, the pay rate for credits, the other Twin City trade schools, etc.

That this agreement has persisted a dozen years is evidence of its general goodness. That similar plans are in force elsewhere is assumed. That new ones may come and that all may be improved in their functioning is full justification for this brief statement. The twelve-year program has accomplished some few things that are definitely measurable. Probably, its greatest worth is never to be known. Teachers-in-training and teachers-in-service have been helped by two parties rather than one. Many students have enjoyed and appreciated the privilege extended. Some, naturally, have expressed dissatisfaction. The university has operated at reduced costs and the institute still withholds comment as to the extra work and annoyance we have brought them. The whole project is in keeping with Dunwoody's announced desire to "serve anybody, anytime, in any way" within the fields of its purpose and within the funds at its command.

DEMONSTRATION CHECK LIST

C. A. Conley, Brewster Vocational School, Tampa, Florida

The shop instructor is always confronted by the question of whether his demonstration has covered all the points that he wanted to cover, and whether all of these points have been clearly demonstrated to the learner. It is never safe for the teacher to rely entirely upon his memory, hence the following plan which was worked out for a demonstration on the variety saw may point the way to apply this method to other jobs as well. The points to be covered are mentioned in question form. In this way it may be used both as a guide for the demonstration or as a set of questions to test the student.

While these questions apply only to the one kind of machine, yet the same method may be used for other work as well.

The Variety Saw

1. Why is it necessary to get permission from the instructor before using this machine?
2. What is the use and purpose of the guard over the saw?
3. When and how would you make adjustments of the saw or dado for clearance above the saw table?
4. How much clearance should the saw have above the saw table for a given job? Example: How high should the saw project above the table for ripping a piece of ⅞-in. stock?
5. What is the right position of the operator while using the saw?
6. When may the motor be safely started?
7. Are loose clothing, such as sleeves, ties, etc., dangerous to the operator of the variety saw? Give reason for your answer.
8. Should small pieces of waste near the saw be removed while the machine is in motion? Give reason for your answer.
9. Do you know which saw to use for each job? such as ripping, crosscutting, or dadoing. Explain your answer.
10. In moving the ripping fence, is it necessary to fasten it to the saw table again? Give two reasons for your answer.
11. What would you do if the saw should bind in the cut as you were ripping a piece of stock? Why?
12. Describe the ripping fence, and how it is used in connection with the variety saw.
13. What special devise would you use in ripping short or narrow stock? Is there any danger in connection with this operation?
14. Explain what is meant by the term "push stick" in connection with the ripsaw.
15. What does the term "ripping a piece of stock" mean? What saw would you use for this operation?
16. In ripping a piece of stock at an angle would you have any use for a jig? Explain the term "jig."
17. What is the cut-off fence, and for what is it used?
18. Would you use the cut-off fence in connection with the rip or crosscut saw?
19. What is the gauge block? Explain its use in connection with the ripping fence.
20. What is the gauge stick and slide? Explain their use in connection with the cut-off fence.
21. How would you set the cut-off fence to cut a given angle? Example: Forty-five degrees.
22. Could you tilt the saw table to cut a given angle, say of forty-five degrees? Explain this operation.
23. What is meant by the term "saw arbor"?
24. Are the threads on the saw arbor right- or left-hand?
25. In mounting a saw on the arbor, which way should the teeth point with reference to the position of the operator?
26. A dado head is composed of how many different kinds of cutters?
27. In cutting a five-eighths groove, how would you determine what dado cutters to use, and how many?
28. Are there any special precautions about the position of the door inclosing the saw while the saw is in motion? Does the position of this door remain the same while the dado is on the arbor whether it is being used or not?
29. If you are waiting your turn on the machine, is there any special reason why you should not lean on the saw table or stand on either side of the machine while someone is operating it? Explain your answer.
30. Give several reasons why you should not try to carry on a conversation while operating the universal saw.

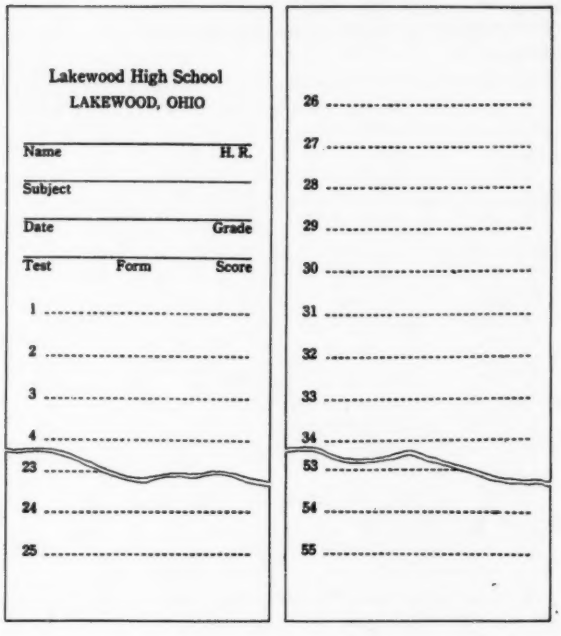
Problems and Projects

ARCHITECTURAL-DRAWING TEST

J. H. McCloskey, Lakewood High School, Lakewood, Ohio

(See Supplement No. 261)

The illustration shown herewith shows an answer sheet which was devised to simplify the giving of tests in general. The answer sheet may be used with pictorial tests, such as



Answer Sheet for Tests

are shown in the supplement, true-and-false tests, multiple-choice tests, completion tests, etc.

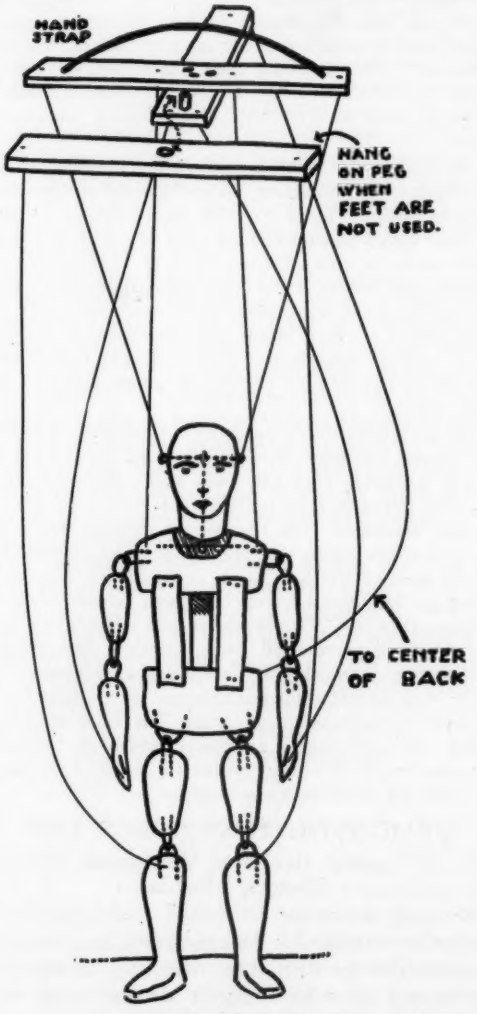
This answer sheet has made the giving of tests in our school a very simple and economical procedure.

HOW TO MAKE AND OPERATE PUPPETS

John G. Kemper, Bremen, Ohio

Especially for those who are making puppets or marionettes for the first time, the following method is probably the easiest and the most satisfactory. The figures are made chiefly of papier-maché which is prepared by crumpling single sheets of newspaper (about 3 sheets for each marionette) and soaking them in water, preferably overnight. Then the paper is torn into fine bits or rubbed on a washboard until pulplike. Next, place the pulp into an old Turkish towel and squeeze or press out as much of the water as possible. If wall-paper paste is not available, flour-and-water paste should be prepared by mixing boiling water with flour until it is of a creamy consistency; be sure the paste is not lumpy. When cool it should be about the consistency of chocolate pie filling. Now thoroughly mix two parts of the paper pulp with one part of paste. If the material falls apart, add more paste; if it is too sticky, add more pulp.

Next, model the marionette's head, shoulders, hips, arms, and legs, as shown in the sketch. Wires should be modeled into the papier-maché as indicated. The marionettes are approximately 12 in. high, the correct size for use in the portable puppet stage described on page 3 of the January, 1933, issue of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION. In modeling the facial features, try to convey the characteristics of the marionette; exaggerate them if necessary. The head and neck, with the T-shaped wire molded into the center of it, is 2½ in. high; the shoulders are 2¾ in. wide (slightly *less* for female figures); the hips are 2½ in. wide (slightly *more* for female figures); the forearms 2¼ in. long, and the legs and feet are 2½ in. long. The upper arms and upper parts of the legs are slightly shorter than the lower parts because allowance must be made for the joints. After all the parts are



Stringing the Puppet

molded, they should be dried for a day or two in strong sunlight, or for several hours in a slow oven. They are then ready to be assembled. The shoulders and hips are joined by three strips of cloth (two in front and one in back) fastened by common pins which are pushed through the cloth and into the papier-maché. When the torso is assembled, it should be about

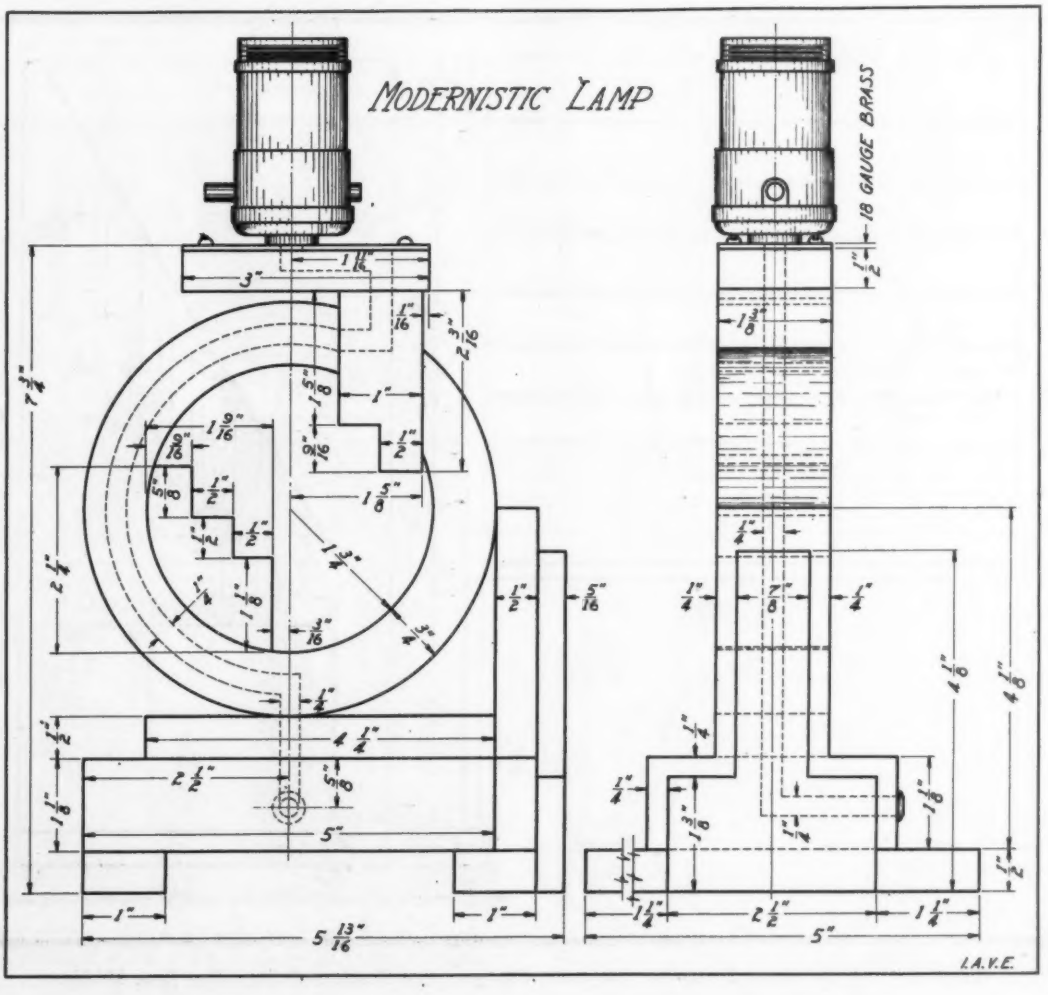
4½ in. long. It is to be understood, of course, that all the measurements given are variable, depending upon the particular character that is being made. In the diagram, the shoulders are shown in cross section to illustrate the method of connecting the head to the body. All joints should work freely; when connected, the head should fall forward and not backward. The next step is to paint the figure; the feet may be painted to resemble shoes and stockings, or, if the character is to be bare-footed, they should be flesh color, as are the hands and forearms. The facial features should be emphasized and exaggerated as is done in theatrical make-up. Hair may be made from old doll wigs, unraveled rope, dyed waste or cotton, or crêpe hair. The costumes should be made of soft, light-weight materials and loosely fitted about the joints and the neck so as not to interfere with the movements of the puppet. Next, make the wooden controller shown in the sketch, the pieces being 8 in. long and ¾ in. wide. Now string the marionette to the controller, using heavy black thread, or, better yet, black carpet thread. This step will be made easier if the two shoulder strings are attached first. The two strings holding the head should be made adjustable at the controller by wrapping the strings securely about thumb tacks. The marionette should hang about 30 in. below the controller, although this measurement is variable, depending largely upon the height of the operator.

To operate the marionette, place one hand under the controller strap. By hooking the proper strings over the thumb and index finger of this hand, the puppet's hands may be operated. The marionette is made to walk by taking the "walking stick" (that to which the leg strings are fastened) in the other hand and tilting it up and down like a teeter; as the legs work, move the entire controller gradually forward. The head is moved by tilting the controller slightly from side to side. To make the marionette bow or bend forward, tilt the controller forward. With a little practice these various movements may be coördinated and the marionette made to do almost anything you wish. In using the puppet stage, the operator stands behind the cyclorama to work the marionette and speaks the lines from memory for the little figure. When two puppets are conversing on the stage, the one talking should make appropriate gestures and movements while the listening puppet should remain quite motionless. This is just a tip so as to avoid confusing the audience as to which marionette is talking. A very entertaining marionette play, arranged by Tony Sarg, is "Jack and the Beanstalk" which may be found in the *Ladies' Home Journal* for December, 1927. Other suitable plays may probably be found at the local public library. As the operator works with the puppets, he will think of countless ingenious and clever things to have them do, some of which may require additional strings.

A MODERNISTIC LAMP

Harry R. Jackson, Indianapolis, Indiana

The lamp described herewith makes a good project for the junior-high-school boy, particularly if he is willing to have his mechanical skill challenged. Turning the ring provides opportunity for chuck work; all other pieces can be made by hand. In turning the ring, it is best to make it in two



parts with a groove in the face of each; then when glued together the opening for the wire is formed.

Modernistic Lamp

A light wood, such as maple, is preferred for the ring, while all other pieces may be of gum or walnut.

The project may be finished natural, or in colors to suit the taste of the student who makes it.

A METAL FLOWER BASKET

R. F. Kranzusch, The Stout Institute, Menomonie, Wisconsin

The limited number of tools and the cheapness of the material required in the construction of the basket described in this article makes it a very desirable project for the junior or senior general shop or for the home-mechanics shop.

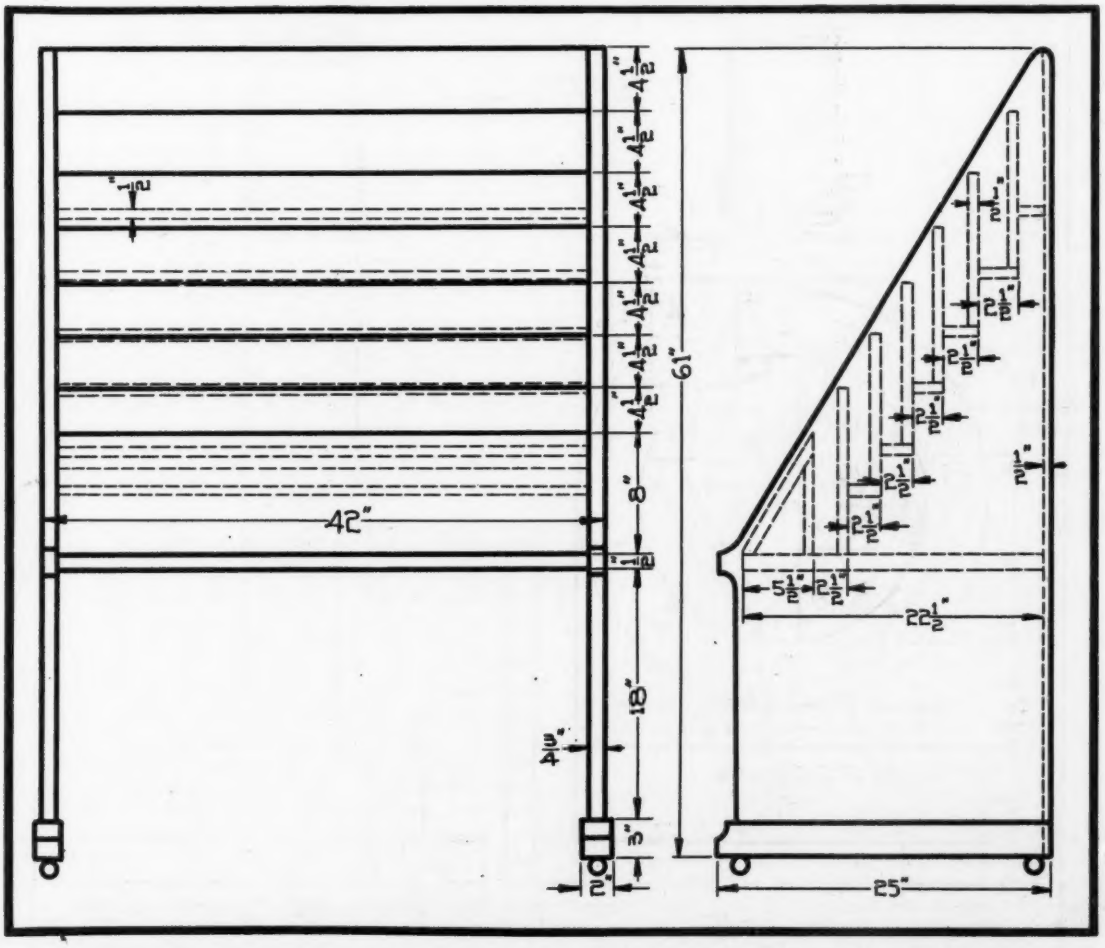
Tools and Equipment: Hack saw; ball-peen hammer; vise; rule; try-square; scratch awl; monkey wrench; file; 3/16-in. drill; stake or piece of pipe; hand or power drill; tin snips; soldering equipment; and the bending fork described on page 199 of the June, 1932, issue of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION.

Materials:

4 pc. No. 12 Gauge Iron, ½ x 18 Legs
4 pc. No. 12 Gauge Iron, ⅜ x 12 Straight Pieces
4 pc. No. 12 Gauge Iron, ⅜ x 7½ Ornaments
1 pc. No. 12 Gauge Iron, ½ x 7 Lower Ring
1 pc. No. 12 Gauge Iron, ½ x 15½ Upper Ring
1 pc. No. 12 Gauge Iron, ½ x 38 Handle

Note: Ring dimensions are for butt joint. Add ½ in. to ⅝ in. to length if other type of joint is to be used.

10 3/16 x ¼-in. r.h. Iron Rivets
2 3/16 x ⅜-in. r.h. Iron Rivets
4 No. 1 Tinners' Rivets



Magazine Rack, Submitted by Carl v. Lindeman, Western State Teachers College, Paw Paw, Michigan

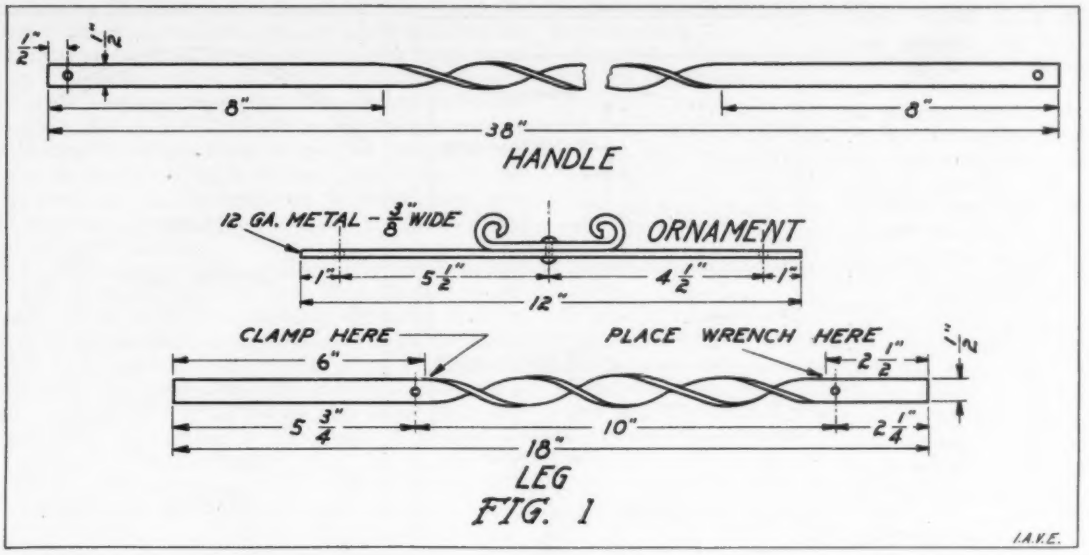


FIG. 1

Procedure

1. *Lay Out Pieces to Length:* With a rule, measure all pieces to the above lengths. Use try-square and mark with scratch awl.

2. *Cut Material:* Use one of the several methods mentioned for cutting off the stock:

a) Vise and monkey wrench.

b) Hack saw and vise.

c) Cold chisel and iron plate.

Of the three mentioned, the monkey wrench and vise, producing a shearing twist, is the quickest method.

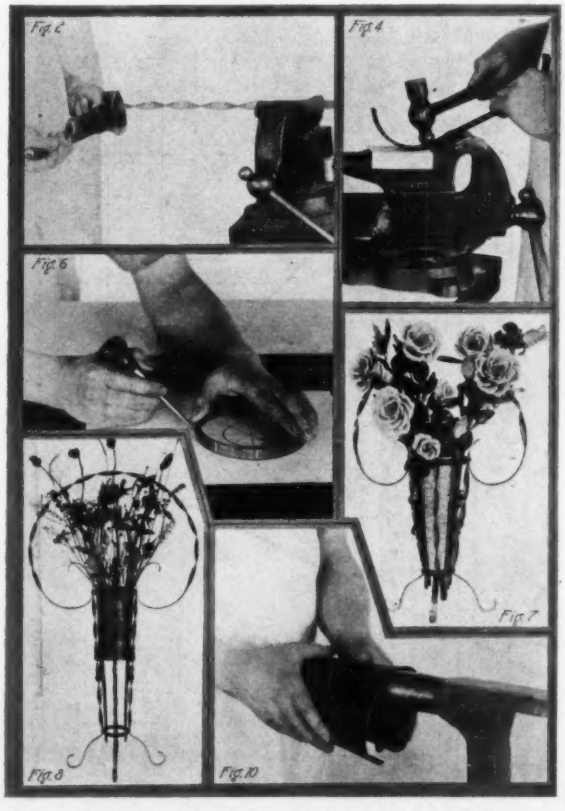


Fig. 2. Twisting. Fig. 4. Forming the ring. Fig. 6. Transposing divisions to ring. Fig. 7. Basket Hammer Marked. Fig. 8. Large Basket. Fig. 10. Forming container.

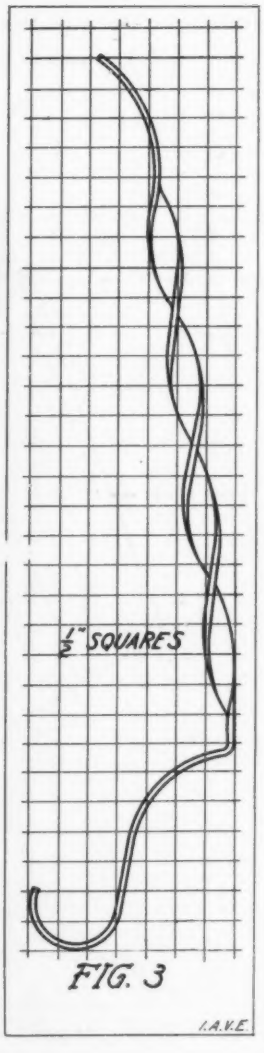


FIG. 3

3. *Finish Ends:* With a file, remove all burrs and sharp edges. (See Unit on End Construction.)

Note: If the metal is to be hammer-marked for ornamentation, it should be done at this time.

4. *Twist the Legs:* Figure 1 shows where the stock should be clamped and where the wrench should be held. With the stock placed in the vise, use the monkey wrench as shown in Figure 2, twist the stock 1½ turns, being careful to keep it in a straight line. A convenient method is to slip a piece of 1½-in. pipe, 8½ in. long, over the stock before twisting. Twist all legs in the same direction and with the same number of turns.

5. *Locate and Drill Holes:* All holes are to be drilled with a 3/16-in. twist drill. See drawing Figure 1 for the proper location of all holes.

6. *Shape Upper and Lower Portion of Legs:* With the bending jig, proceed to bend the legs to the shape illustrated in Figure 3. Where the bending jig is not used, these pieces may be formed over a stake or a piece of pipe.

7. *Form the Rings:* Figure 4 shows a method of forming a ring. Use one of the several joinings as indicated in Figure 5 or 5A. Use the butt joint only where brazing or welding can be done.

8. *Lay Out and Drill the*

Holes in the Rings: Figure 6 shows how divisions may easily be laid out on rings. On a piece of paper, lay out circles corresponding to the two diameters of the rings. Using a pair of dividers, lay out eight divisions equally spaced upon the circumference. By laying the ring on the paper just over the circle drawn, transpose the equal divisions to the ring. Where a lap or miter joint is used, see that one division falls on the joint. Centerpunch on these marks in the center of the stock and then drill.

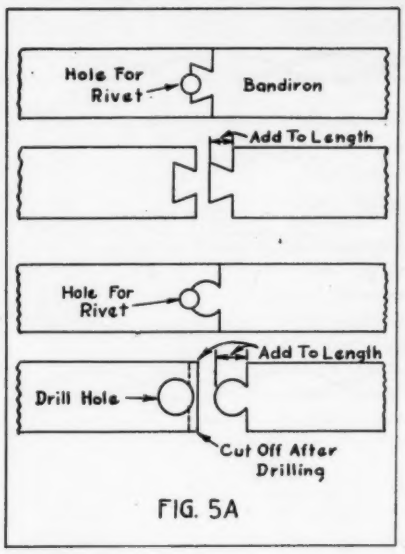


FIG. 5A

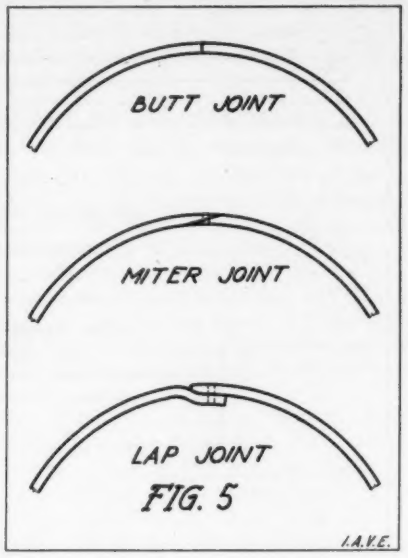


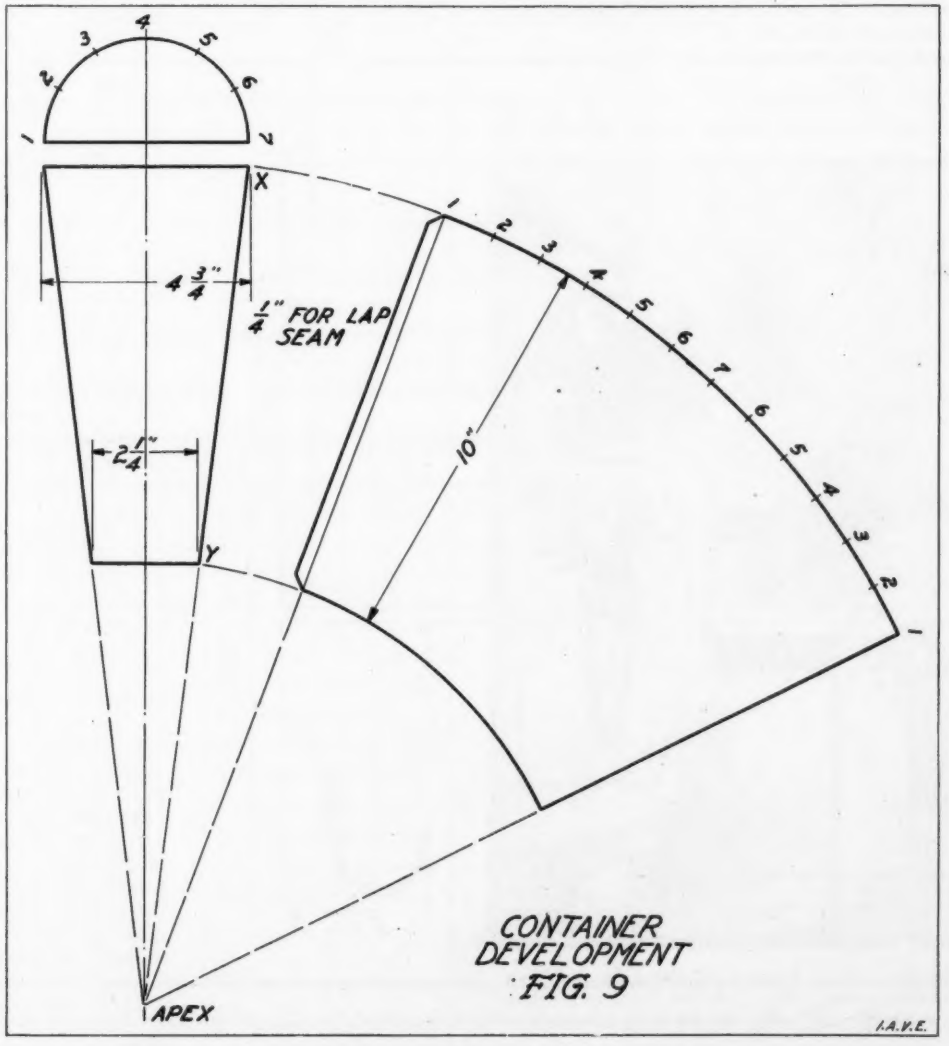
FIG. 5

I.A.V.E.

9. *Shape Ornaments:* With bending jig, twist the pieces for the ornaments to the shape as illustrated in Figure 1. These pieces may be drilled and riveted to the four straight pieces between the legs before the final assembly.

10. *Twist and Shape Handle:* The handle is twisted four complete turns, using the same process as involved in twisting the legs. The handle is then drilled and formed to the desired shape.

11. *Assemble:* Assemble and rivet the upper and lower



ring to one leg. Do likewise with the opposite leg. Fasten the remaining two legs to the lower ring, keeping in mind that the handle must be assembled together with the legs to the upper ring. It is advisable to leave the handle off until the remaining pieces have been riveted in place. Two machine screws and nuts can be used to hold the upper end of the legs in place while riveting the straight pieces. Remove the machine screws and rivet the handle and legs to the ring. Check to see that the legs set evenly and that the handle has the desired shape. Any of the parts may be bent to give the desired effect. The basket is now ready for finishing.

12. *To Finish Basket:* The color of the lacquer or enamel to be applied depends upon the taste of the individual and the color scheme of the room in which the basket is to be used. If an antique effect is to be brought out on the basket that has been hammer-marked, a coat of black lacquer or enamel should be applied. When dry, rub the surface with a piece of emery paper to bring out the high spots. The basket in Figure 7 has been finished in this manner. It is advisable to apply a coat of wax to the basket to prevent the high spots from tarnishing.

Note: To make a larger-sized basket, the following dimensions are suggested:

4 pc. No. 12 Gauge Iron, ¾ x 46 Legs
4 pc. No. 12 Gauge Iron, ½ x 28¾ Straight Pieces
4 pc. No. 12 Gauge Iron, ½ x 12½ Ornaments
1 pc. No. 12 Gauge Iron, ¾ x 14 Lower Ring
1 pc. No. 12 Gauge Iron, ¾ x 21 Upper Ring
1 pc. No. 12 Gauge Iron, ¾ x 48 Handle

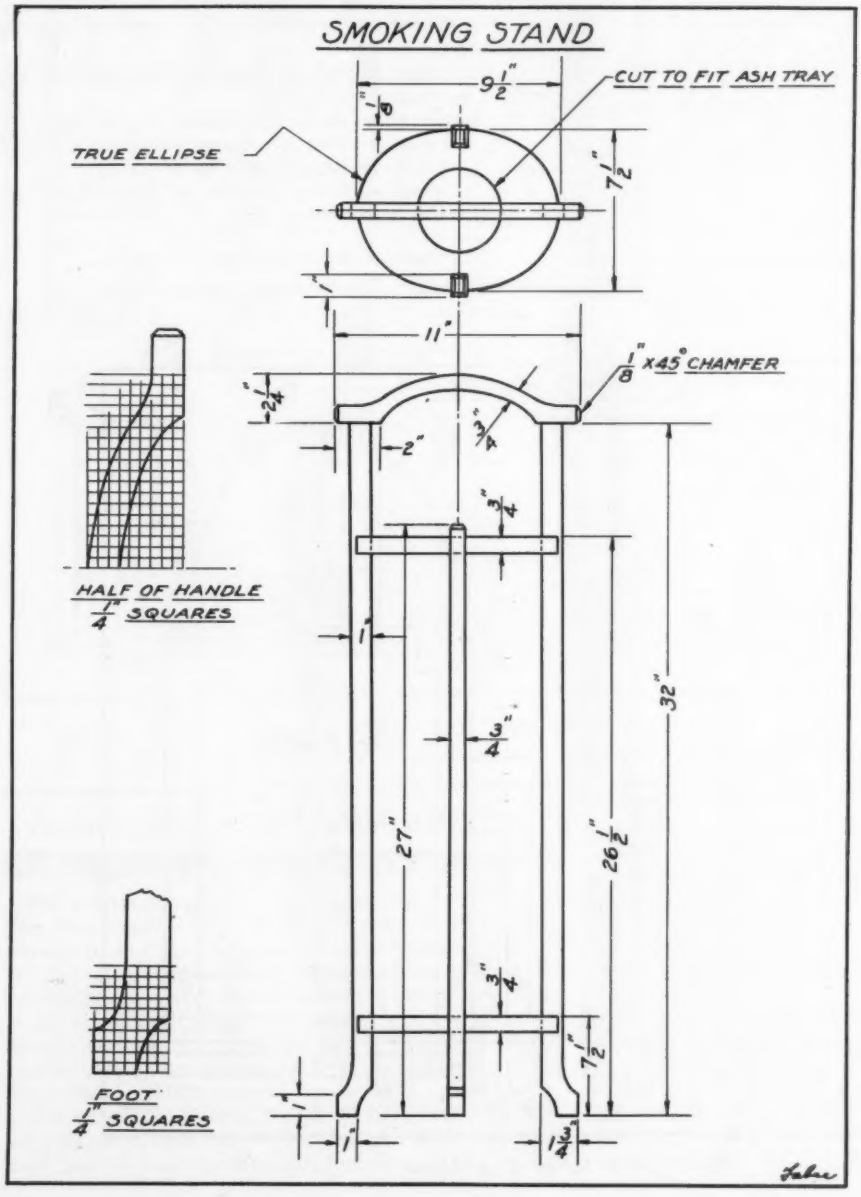
Figure 8 shows a large-sized basket.

The Container

Figure 9 illustrates a method of laying out the container. Practically any light-gauge sheet metal can be used. Figure 10 illustrates a method of forming the body of the container over a stake or a piece of pipe. Rivet the ¼-in. lap seam, for which material has been allowed, using four 1-lb. tinner's rivets. For the bottom, cut a round piece 1/16 in. larger than the bottom inside diameter of the container. This piece is slipped into place from the top of the container and soldered from the underside. The seam should be soldered at this time making the container water-tight.

If cut flowers are kept in water, it is advisable to use a glass jar or vase set into the container. Water kept in the container directly, in time, would rust it, and cause leaks.

Finish container to harmonize with the rest of the basket. If an antique effect is desired, apply a coat of aluminum bronze, then splatter or dab on black lacquer. The basket in Figure 7 has a container finished in this manner.



A SMOKING STAND

Byron E. Whiteman,
Academy High School,
Erie, Pennsylvania

The smoking stand shown in the accompanying illustration was designed to supply the elementary woodworking class with a project which is refined in design, interesting to the student, useful in the home, and simple enough in construction so as not to be beyond the limited ability of the student.

This project may be made of poplar, gum, or birch, and stained to imitate walnut or mahogany. The kind of stain employed should be determined by the finish of the furniture with which the smoking stand is to be used.

CIRCULAR SAWS, THEIR CHARACTERISTICS AND USE — V

John E. Doren, Supervisor of Industrial Education, Eureka, California

(Continued from February)

The Circular Rough-Cutting Combination Saw

A. The *rough-cutting combination saw* is designed for convenience; the same blade may be used for any kind of rough cutting in any kind of wood. It may be used:

1. For rough ripping, rough crosscutting, rough mitering.
2. For cutting rough, crooked lumber without first flattening one face or jointing one edge.
3. For cutting green or poorly seasoned lumber as well as dry lumber.

B. Characteristics of the rough-cutting combination saw:

1. The body of the blade is of uniform gauge throughout.
2. The teeth are in groups; usually four crosscut teeth and one rip tooth to each group, but some saws have only two crosscut teeth to each rip tooth.

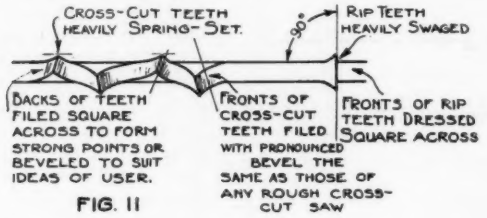

CROSS-CUT TEETH HEAVILY SPRING-SET.
30°
RIP TEETH HEAVILY SWAGED
BACKS OF TEETH FILED SQUARE ACROSS TO FORM STRONG POINTS OR BEVELED TO SUIT IDEAS OF USER.
FRONTS OF CROSS-CUT TEETH FILED WITH PRONOUNCED BEVEL THE SAME AS THOSE OF ANY ROUGH CROSS-CUT SAW
FRONTS OF RIP TEETH DRESSED SQUARE ACROSS

FIG. 11

3. The crosscut teeth:

a) Are heavily spring-set for clearance.

b) Have fronts filed with a pronounced bevel (see Fig. 11).

c) Have raking front edges, usually one unit of rake to three or four units of height, as shown in Figure 12.

d) May have backs filed square across to form strong points, or beveled to suit the ideas of the user.

4. The rip teeth:

a) Are broadly swaged for clearance.

b) Have their fronts dressed square across.

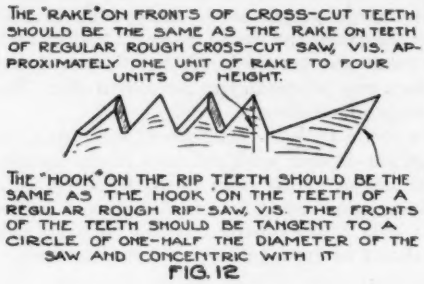

THE "RAKE" ON FRONTS OF CROSS-CUT TEETH SHOULD BE THE SAME AS THE RAKE ON TEETH OF REGULAR ROUGH CROSS-CUT SAW, VIS. APPROXIMATELY ONE UNIT OF RAKE TO FOUR UNITS OF HEIGHT.
THE "HOOK" ON THE RIP TEETH SHOULD BE THE SAME AS THE HOOK ON THE TEETH OF A REGULAR ROUGH RIP-SAW, VIS. THE FRONTS OF THE TEETH SHOULD BE TANGENT TO A CIRCLE OF ONE-HALF THE DIAMETER OF THE SAW AND CONCENTRIC WITH IT

FIG. 12

c) Have fronts hooked, the same as teeth of the rough rip-saw, viz., the fronts of the teeth tangent to a circle of half of the diameter of the saw and concentric with it (see Fig. 7).

d) Are dressed approximately 1/32 in. shorter than the crosscut teeth.

e) Have gullets in front of them which are deep and well rounded to chamber the sawdust.

C. The cutting action of the combination circular saw:

1. Is slower than either the regular rough rip- or rough crosscut saw, and the cutting should not be forced.
2. The saw will cut best if the teeth are lightly sidedressed and jointed before each filing.

Questions for Thought and Discussion

1. Why is the combination saw a popular tool?
2. In what ways does the cutting action of the combination

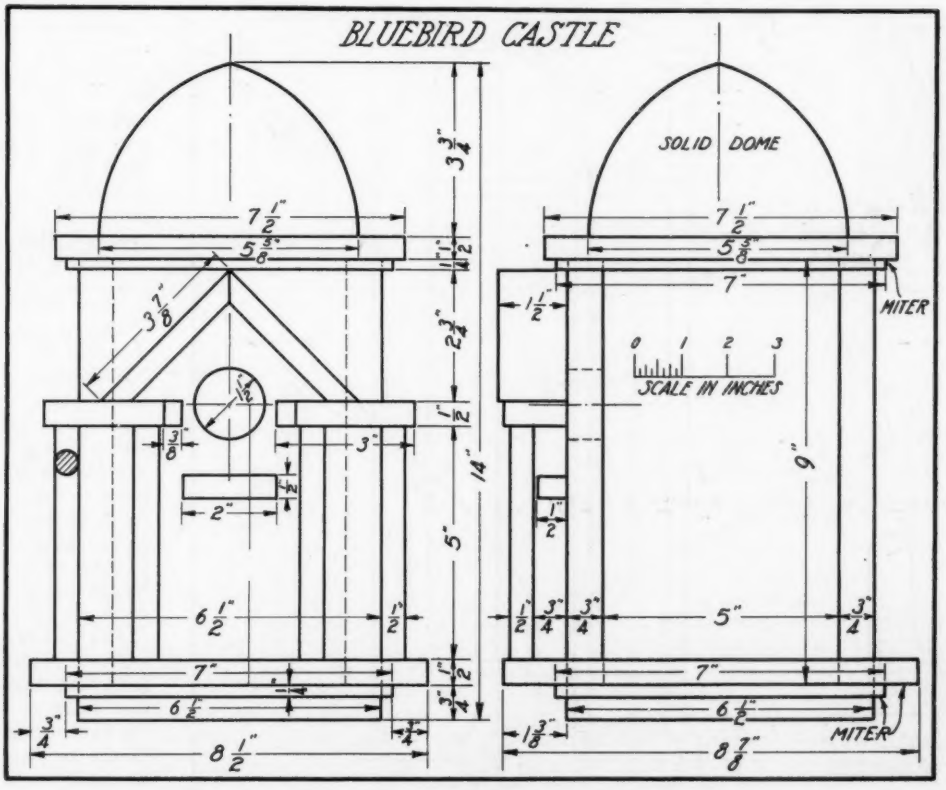


Fig. 1. Submitted by H. A. Lynch

saw differ from the cutting action of (*a*) the rough ripsaw, (*b*) the rough crosscut saw?

3. How would you describe the rough-cutting combination saw so that anyone could positively identify such a saw at sight?

SEVERAL BIRD HOUSES

H. A. Lynch, Forest Park School, Fort Wayne, Indiana

There are approximately 1,500 varieties of birds in North America, and out of this number only about 25 or 30 different varieties are likely to use artificial shelter. Elaborate bird houses are frequently ignored by the birds year after year, and it is a very common thing to see beautifully constructed shelters occupied by the hateful English sparrow because the houses were given colors which were not attractive to the birds for which they had been built. Then too, openings and interiors must be of the right shapes and dimensions.

Bluebirds prefer a single-room house placed in a remote spot and painted some inconspicuous color. The bluebird castle shown in Figure 1, while quite attractive to the eye, is also acceptable to the bird. The base of this bird house is fastened with screws in order that it may be removed for cleaning. Three ½-in. holes drilled on each side beneath the top take care of the ventilation.

Martins prefer a colony house painted white. These houses may be fastened on top of a barn or upon a pole so that they are about 15 or 20 ft. above the ground. The Mt. Vernon martin house shown in Figure 2 has the compartments made in such a way that they may be removed with the back for cleaning. Provisions for ventilating are made by drilling two or three ½-in. holes above each window.

The bird houses shown herewith were made at the Forest Park School and they took sweepstake prizes at the annual Bird House Show at Fort Wayne, Indiana.

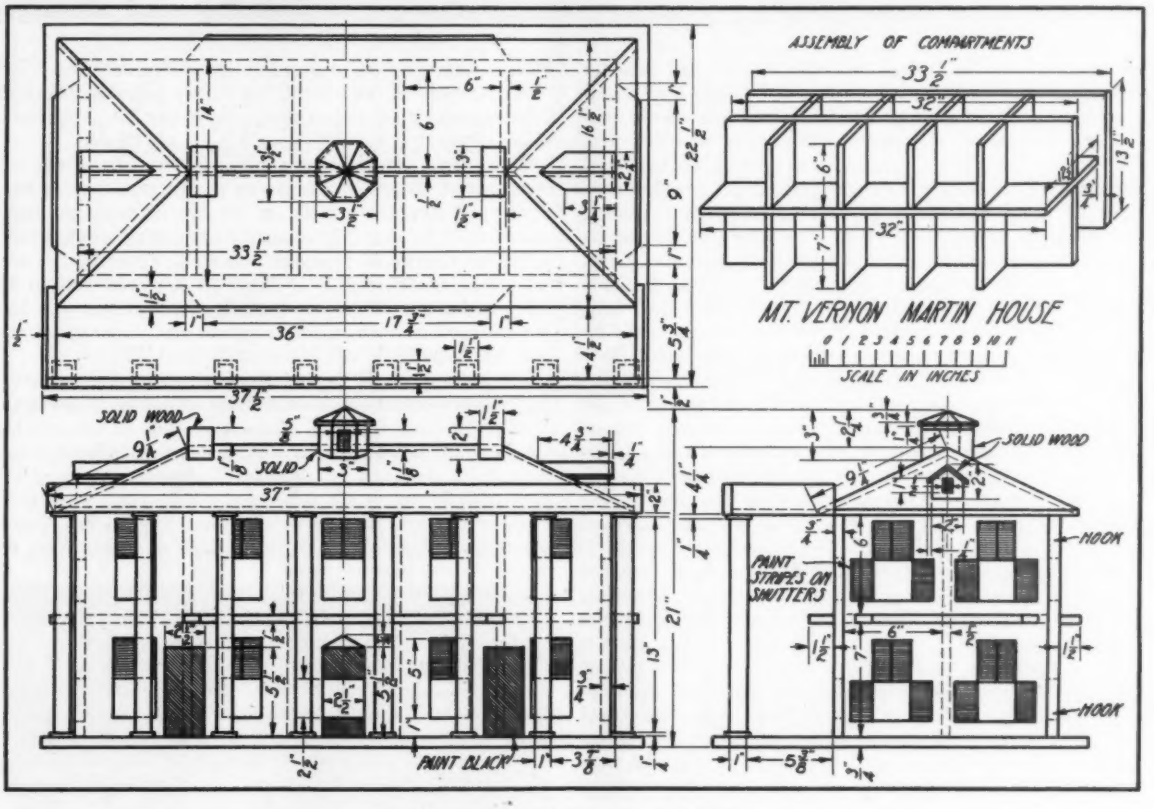


Fig. 2. Submitted by H. A. Lynch

Associations, Conventions

The seventh annual A.V.A. convention was held at Kansas City, Mo., December 7 to 10, 1932. As was to be expected, the attendance could not be called record-breaking, although O. H. Day, chairman of the local arrangement committee, had everything planned so that all those who might come would be fully accommodated. He was ever on the job, as were all of his able assistants. The same may be said of Laurence Parker and his helpers, who had charge of the publicity. All of them did yeomen service to make the convention a success.

The commercial exhibits were housed in booths that were not only tastefully decorated, but very practically built. This work had all been prepared ahead of time at the Lathrop Polytechnic Institute of Kansas City, and the teachers and students who worked on the project are to be highly complimented.

Through all of the meetings, general as well as sectional, ran the one unifying theme, "How Can Vocational Education and Industrial Arts Work Be Made to Contribute Most to the Needs of the Times."

Unfortunately, Wesley A. O'Leary, president of the American Vocational Association, who had guided the activities of the organization throughout the year, was unable to attend this crowning event of his administration because of ill health. Everyone present at the convention felt real regret that the leader of the A.V.A. was absent.

Both general and sectional meetings, in the main, were well attended. The first general meeting was held on Wednesday at 8 p.m. in the beautiful Thomas A. Edison Hall of the Power and Light Building. At this meeting it was especially

emphasized what the federal Smith-Hughes Act had done for vocational education in this country, and it was also shown that real vocational education is far from being anticultural.

The industrial-arts sectional programs were especially rich. The topic, "The Status, Trends, and Outlook of Industrial Arts in the United States" was discussed under the chairmanship of Homer J. Smith, professor of industrial education, University of Minnesota. Charles F. Bauder, director of industrial arts, Philadelphia, showed what the East was doing, while T. T. Lindsey, director of industrial education, Peabody College for Teachers, Nashville, recounted what had been done in the South. The progress in the West was presented by George B. Cox, director of industrial education, Oregon State College, Corvallis, Oreg., and George K. Wells, state supervisor of industrial education, Indianapolis, showed what the North Central States had done. Through all of these discussions, it was plainly evident that the leaders had a broad outlook on what industrial-arts work should accomplish.

At the industrial-arts sectional meeting held Friday, the topic of "Operating Effectively on a Reduced Budget" aroused considerable interest. William L. Hunter, head of the department of industrial arts, Iowa State College, Ames, was the chairman. O. B. Badger, supervisor of industrial education, Tulsa, Okla., spoke on "How the City Supervisor Solves the Problem." Ross C. Cramlet, Junior High School, Des Moines, Iowa, showed how the classroom could do constructive work in reducing costs, and Frederic Bohning, instructor in industrial arts, Forest City, Iowa, showed how the problem could be solved in the small school. It was interesting to see how many of those in the audience had grappled with the same problems and there were many who were eager to contribute to the general fund of knowledge.

The Industrial-Arts Luncheon which was held on Friday at noon under the chairmanship of Dr. William E. Warner, associate professor of industrial-arts education, Ohio State University, Columbus, again held a unique position in the entire industrial-arts offerings of the convention. The topic of this meeting, "What Next in Industrial-Arts Education," was ushered in by a short résumé of how the New York luncheon, which had been given in honor of the men now in positions of leadership who had begun their teaching before 1900, appropriately acted as the opening chapter of that which was to be continued in the luncheon at Kansas City where the men who had entered the field since 1900 had done outstanding work were honored. The attendance at this luncheon was very good, and all listened with great interest to the address on "Clarification Through Concept Analysis," by Everett Wood, in charge of industrial arts, John Burroughs School, St. Louis, Mo.; "What Next in Physical Planning?" by Elroy Bollinger, chairman industrial-arts department, University of North Dakota, Grand Forks; "Accounting for Ourselves," by Frank Moore, supervisor board of education, Cleveland, Ohio; and "The Challenge of the Future," by Homer J. Smith, chairman industrial-education department, University of Minnesota, Minneapolis.

With such a showing by the industrial-arts men, it was not surprising at all that at the House of Delegates session held Friday at 2 p.m., the Association, through its delegates, voted unanimously to amend its Constitution, adding another vice-president who would represent Industrial Education. It was not surprising either that the honor of being the first to fill this position should fall on Prof. R. W. Selvidge, who had worked hard on making the industrial-arts programs of the past few years such valuable contributions.

The last meeting of the industrial-arts group was on Saturday morning under the chairmanship of Clyde A. Bowman, dean of the Stout Institute, Menomonie, Wis. At this meeting the Committee on Standards of Attainment in Industrial Arts through its chairman, Dr. William T. Bawden, editor of the *Industrial Education Magazine*; and the Committee on Tests in Industrial Arts through its chairman, Roy R. Van Duzee, supervisor industrial-arts department, West Allis, Wis., reported on the progress made.

Other sectional meetings held on Unemployment Relief Through Vocational Education; Training To Meet the Changing Demands of Employment; Junior Pre-Employment Vocational Training; Obligations of Part-Time and Industrial Education in Meeting Economic and Social Situations: Vocational Guidance and Vocational Rehabilitation; and numerous others might be reported on, but unfortunately space will not permit.

The new officers elected by the Association for the coming year are:

President, Dr. Ray Fife, state supervisor agricultural education, Columbus, Ohio. Mr. C. M. Miller, director of vocational education, Topeka, Kans., was reëlected secretary. The following new vice-presidents were elected: Dr. A. K. Getman, state supervisor agricultural education, Albany, N. Y.; Jacob Spies, supervisor commercial department, Vocational School, Sheboygan, Wis.; Elisabeth Amery, state supervisor home-economics education, Baltimore, Md.; and R. W. Selvidge, professor industrial education, University of Missouri, Columbia, Mo.

EPSILON PI TAU INITIATION

One of the special features of the A.V.A. convention at Kansas City, was the installation of the new Zeta chapter of the Epsilon Pi Tau fraternity. With impressive ceremonies, this honorary industrial-arts teachers fraternity granted its charter for a new chapter to State Teachers College, Peru, Nebr. The charter members of the new chapter initiated at Kansas City were Prof. A. V. Larson, Prof. Carl R. Lindstrom, Willard

(Continued on page 9A)

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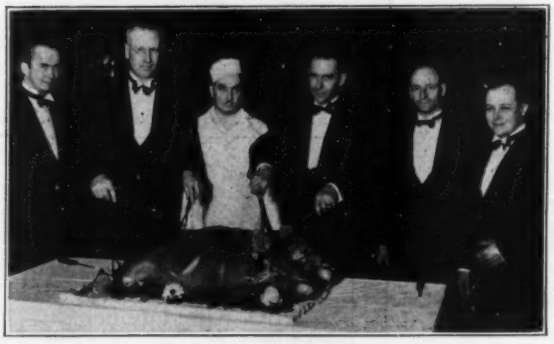
(Continued from page 156)

K. Cox, S. Clay Coy, Okla C. Dahlgren, Stephen C. Gaines, E. Albin Larson, Edward J. Pedersen, Gerald Tyler, Paul V. Wilcox, B. F. Chard, and Carl F. Bardwell, all from State Teachers College.

Besides the foregoing new members, the following men now active in the fields of industrial arts were initiated: O. B. Badger, director vocational and industrial-arts education, Tulsa, Okla.; Clyde A. Bowman, dean School of Industrial Education, The Stout Institute, Menomonie, Wis.; Samuel Hadden, chairman department of industrial-arts education, State Teachers College, Greeley, Colo.; Victor J. Smith, professor industrial-arts education, State Teachers College, Alpine, Tex.; and Clemmer R. Wood, professor industrial-arts education, Oklahoma A. and M. College, Stillwater.



Initiation Banquet, Zeta Chapter, Epsilon Pi Tau Fraternity, December 9, 1932, in Francis I Room, Hotel Baltimore, Kansas City, Missouri.

Reading from left to right: Dr. William E. Warner, National Secretary-treasurer, Ohio State University, Columbus, Ohio; Prof. Orville E. Sink, Member National Policies Board, Head Industrial Arts, Ball State Teachers College, Muncie, Indiana; Chas. C. Carroll, Chef, Baltimore Hotel; Prof. Rudolph L. Schwanzle, Toastmaster, State Teachers College, Emporia, Kansas; Dr. Homer J. Smith, Member National Policies Board, University of Minnesota; Prof. Elroy Bollinger, Member National Policies Board, University of North Dakota, Grand Forks, North Dakota.

The impressive initiation ceremonies which were conducted by Prof. Elroy Bollinger, University of North Dakota, were then followed by a delightful banquet, which was in charge of Prof. Rudolph L. Schwanzle, State Teachers College, Emporia, Kans. At this banquet, Dr. Homer J. Smith, University of Minnesota, made the award of honors; Prof. Fred C. Whitcomb, Miami University, Oxford, Ohio, presented the charter; Prof. C. R. Lindstrom, State Teachers College, Peru, Nebr., responded for the initiates; and Dr. William E. Warner, of the Ohio State University, gave a thorough explanation of what Epsilon Pi Tau has already accomplished and is preparing to do in the future.

JANUARY MEETING OF THE BOSTON VOCATIONAL SOCIETY

The Boston Vocational Education Society held its annual meeting on Saturday, January 7. It was attended by 112 members and friends of the society.

Dr. Daniel L. Marsh, president of Boston University, spoke on the subject, "Education for a Life Worth Living." He said that since education is our life, it should teach us to see things in their true proportion. When life becomes jaded and dull, and we wonder if life is worth living, then education should serve as an eye-opener. The historian of the future, said Dr. Marsh, will recognize the period through which we are pas-

(Continued on page 11A)

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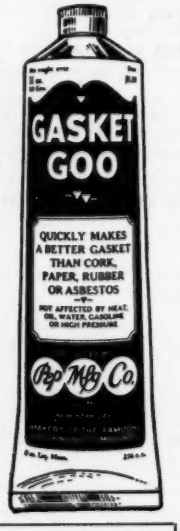
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(Continued from page 9A)

sing as a major cycle in the progress of humanity akin to the breakdown of the feudal system. The future can be determined, to a large extent, by those in education, and should be spiritual rather than material. — *Louis A. Van Ham.*

MICHIGAN INDUSTRIAL-EDUCATION SOCIETY

The Michigan Industrial-Education Society will hold its sixth annual meeting April 20–22, at Muskegon.

Mr. J. B. Yingling, Supervisor of Industrial Education, Wichita, Kansas, will give a talk on "The Future Men of Industry Movement." At the annual banquet on Friday evening, addresses will be delivered by Frank O. Holt, of the University of Wisconsin, on "The Teacher and the Present Troubled World"; by Major Floyd M. Evans, of the Michigan Board of Aëronautics, on "What the Schools Should Teach in Aëronautics"; and another address by Wm. B. Stout, president of the aircraft division of the Ford Motor Company.

At the Saturday noon luncheon, Mr. Herb Heilig, of the Appleton Vocational School, and Mr. Ralph T. Guyer, of the Muskegon Central Junior High School will give talks.

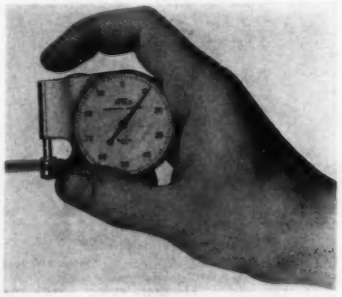
In addition to the general meetings, there will be a number of sectional and round-table sessions. Conducted tours of the local schools and industrial plants will be made.

Information regarding the meetings and speakers, or hotel arrangements, may be obtained from Mr. Alfred H. Meyer, secretary, Grand Rapids, Mich.

SchoolShopEquipmentNews

NEW AMES THICKNESS MEASURE

The B. C. Ames Company, Waltham, Mass., has announced a new low-priced, dial thickness gauge for measuring mechanical parts, paper, sheet metal, cardboard, veneer, glass, leather, and wire material.



The Ames thickness measure is easy to read, accurate, speedy in operation, convenient, durable, and adjustable.

The dial is graduated in thousandths, and measurements in half-thousandths of the inch are plainly indicated.

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NEW ADJUSTABLE CLAMP CATALOG

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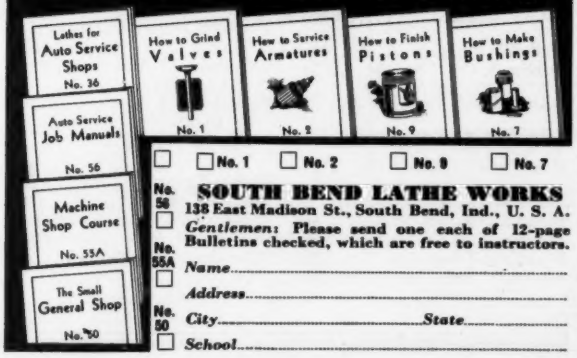
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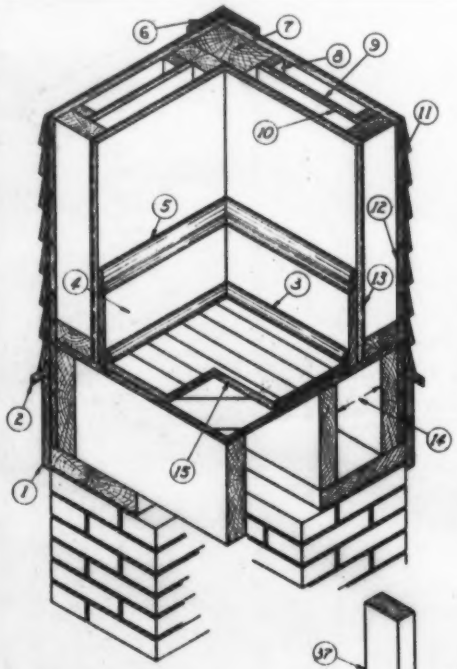

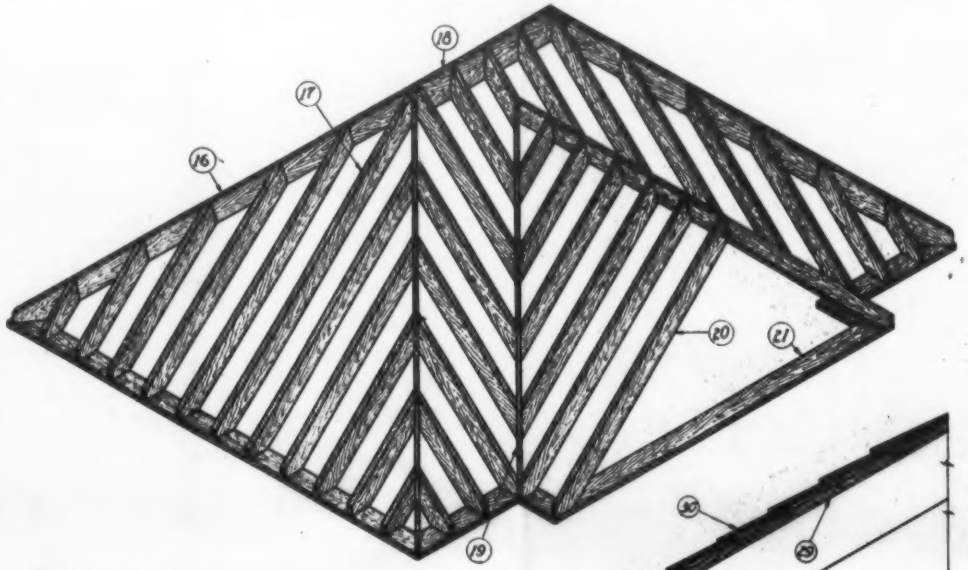

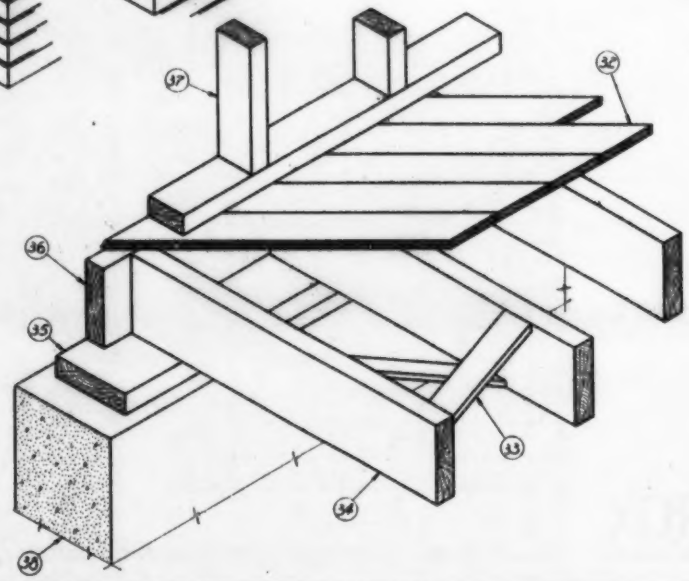

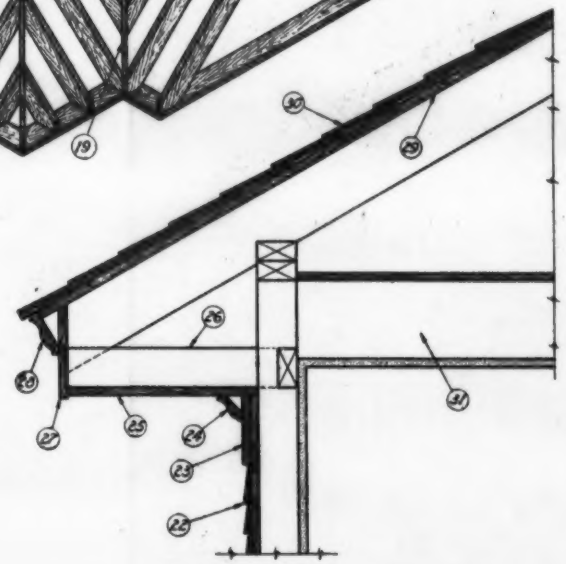

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B – baseboard
C – bed molding
D – bridging
E – ceiling joist
F – common rafter
G – corner board
H – corner post
I – crown molding
J – drip cap
K – fascia
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M – floor shoe
N – foundation
O – frieze board
P – furring
Q – grounds
R – header
S – hip rafter
T – jack rafter
U – joist
V – lap siding
W – lath
X – lookout block
Y – no name
Z – paper
a – plancher
b – plaster
d – plate
e – ridge board
f – roof boards
g – rough flooring
h – sheathing
j – shingles
m – sill
n – stud
p – valley rafter
r – water table

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DIRECTIONS:- In numerical order identify the parts on the drawings. Find the name of the part in the alphabetical list, and on the answer sheet, after the number of the part, place the letter that is in front of the name of the part on the alphabetical list. Observe that some letters are capitals, and some are small letters. DO NOT WRITE OR MARK ON THIS SHEET

I.A.V.E.

Submitted by J. H. McCloskey, Lakewood, Ohio

Described Elsewhere in This Issue

Mar 1933

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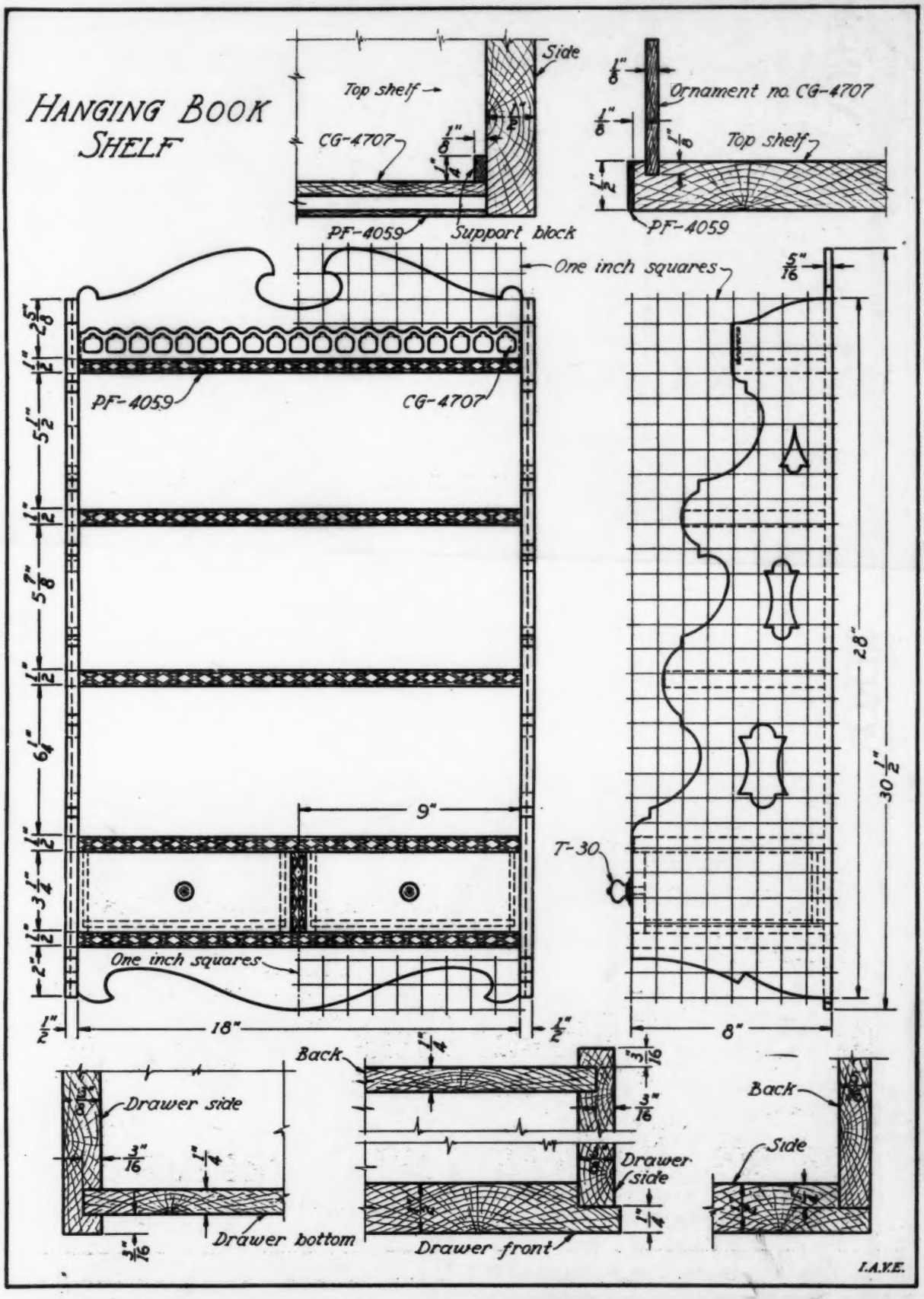

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